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Published monthly by Reinhold Publishing Corporation, 330 West 42nd St., New York 18, N. Y. Ralph Reinhold, Chairman of the Board; Philip H. Hubbard, President; H. Burton Lowe, Executive Vice President; F. P. Peters, Vice President and Secretary; W. P. Winsor, Vice President; G. E. Cochran, Vice President; J. G. Belcher, Vice President; Merald Lue, Vice President; Francis M. Turner, Vice President. Price 50 cents a copy. Payable in advance, one year, $2.00; two years, $3.00; three years, $4.00; five years, $5.00 in U. S. and U. S. Possessions and Canada. In all Latin American countries: one year, $10.00; two years, $16.00; three years, $20.00 All other countries: one year, $15.00; two years, $25.00; three years, $30.00. (Remit by New York Draft.)

Printed by Publishers Printing Co., New York, N. Y. Reentered as second class matter July 19, 1951, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

Established in 1929 as Metals and Alloys.

Materials & Methods®

THE MAGAZINE OF MATERIALS ENGINEERING

VOLUME 34, NUMBER 4 — OCTOBER 1951

NEXT MONTH: Heat Treating Boron Steels . . . . Supply and Uses of Zinc Copper Brazing . . . . De-Enameling Steel . . . . Silicon Carbide Refractories vs Alloys . . . . Die Castings in Microphones . . . . Machining Laminated Plastics . . . . Joining Metals and Nonmetals by Stitching . . . . COLD HEADED PARTS (Materials & Methods Manual No. 76)

"Those blanks aren't scrap... they're saleable steel", agreed Norm

Waste is something Norm can't stand. The same goes for Tom Brinker, manufacturer of portable welding units and a long-time Inland customer. "Every time you form a lamination for your welder," Norm observed, "you leave a 4 x 7 inch piece of 22 gauge electrical sheet steel that you can't use. Why not let us find you a customer for those blanks?"

Norman Grant is an Inland Steel sales representative. His experience told him that those 4″ x 7″ blanks had more than scrap value. Especially at a time when steel is in such great demand. With his trade contacts, Norm was sure he could find a buyer.

A few days later, on his way to visit another Inland customer, Norm had almost driven past the plant of an outboard motor manufacturer when he got a flash . . . "motors!" He stopped. Sure enough, that manufacturer had a pressing need for steel for his magnetos . . . and 4″ x 7″ was a perfect size.

Result: An Inland customer's profit was augmented by the sale of otherwise waste blanks and a motor manufacturer got steel he sorely needed. INLAND STEEL COMPANY, 38 South Dearborn Street, Chicago 3, Illinois.

Your scrap is needed by the steel industry for national defense.

Names used are fictitious.

Making your steel is only part of our job.

The Materials Outlook

Rumor of the month -- a new stainless steel series in which nickel is replaced with titanium. As an alloying element titanium is in fair to good supply. Nickel remains extremely short. . . . The chromium-titanium stainless steels seem to have many of the properties of 18:8. They melt easily, but rolling difficulties have held up developments. . . . Several of the stainless producers are said to be ready for announcements, although many men in the industry are still skeptical.

Tire and rubber companies have been notified their demands for rubber will be met in full starting Jan. 1. Stepped up synthetic production will permit allocation "on the basis of need" in the first quarter of '52. This news comes in the face of record consumption estimates for next year. The same rules on a fixed percentage of synthetic in civilian products will hold. The reason for the improved supply is the reactivation of the government synthetic plants. Petroleum-base plants are running at capacity; the alcohol-base plants will catch up in the near future.

The defense program has made some fundamental changes in the manufacturing picture that have gone unnoticed. Packard Motor Car Co. will double the number of its suppliers as the combined car, jet engine and marine diesel program get under way. Over 2500 suppliers are needed for the combined setup, compared with 1100 in straight automobile manufacture.

The heavy demand for consumer goods in '48, '49 and '50 have brought significant changes in the steel production balance. . . . Hot rolled sheet and strip capacity increased 30% in three years. Cold rolled sheet and strip capacity had a 25% expansion. Even bigger was the 49% increase in electrolytic tin plate potential, and the 43% jump in pipe and tube capacity. Electric welded pipe and tubing went up 153%, largely on natural gas pipe line demands. . . . Other steel products showed more modest rises. The capacity gain for heavy structural shapes and piling increased 12%, while plates show a gain of less than 6%. Wire rod capacity moved up less than 3%, and hot rolled bars (exclusive of concrete reinforcement bars) had a very slight decline. . . . Steel capacity rose 11%, while hot rolled capacity increased 13%. Hot rolled capacity was 80% of raw steel capacity at the end of 1950, compared to 78.7% three years earlier.

Improved silicone resins for electric insulation will bring about important changes in the renewal parts and service shop businesses of the electrical industry, according to a G-E spokesman. The exceptional heat resistance of the silicone resins put them closer to the ideal material for electrical equipment insulation than anything now in use. . . . Alkyd and

(Continued on page 4)

The Materials Outlook *(continued)*

melamine resins modified with new silicones have solvent and abrasive resistance approaching organic resins, with superior heat resistance. These combinations may lower costs for such materials significantly. It is conceivable that insulating resins tailored to specific temperature requirements will be produced.

> A light metal casting material, ML Aluminum Alloy, has been developed by the Air Force for elevated temperature use. ML contains small percentages of copper, nickel, magnesium, manganese, chromium, vanadium and titanium in the aluminum base. . . . Casings, supports and other aircraft parts can be designed to operate at 500 to 600 F, instead of in the 200 to 300 F range formerly used. At 600 F ML supports 6600 psi for 1000 hrs. Maximum tensile strength is 17,300 psi at the same temperature.

Fiberous silica insulation originally developed in batt form for Air Force jets is now being adapted to other uses. Originally, it protected personnel and structures from high temperatures (up to 1800 F), with less than half the weight and bulk of comparable materials. . . . One new use is in sleeving for electric separators on thermocouple leads. . . . Essential properties of the material are chemical and temperature resistance of pure silica. Fiber diameter is 0.00020 to 0.00040 in. and specic heat is 0.19. The nominal thickness of the batt is 3/16 in. and the surface density is 0.05 lb per sq ft . . . Applications are expected in thermal and electric insulation, filter materials and plastic laminates.

> The use of custom-made technical ceramics as machine parts and inserts is increasing. . . . Vitrified ceramics, especially with large amounts of aluminum oxide, are tough and even harder than some of the sintered carbides. The ceramics are usually cheaper, too, since they are formed in the unfired state while still soft. Forming methods have been developed to hold close tolerances, especially on flat and round surfaces. . . . Ceramics are rigid, non-magnetic, and do not corrode or carbonize. They can take high compressive loads, and proper design takes advantage of this property.

A class of hardenable resins called Ethoxylines are being used as adhesives for aluminum, brass, steel and copper. These resins harden without the evolution of water or volatile matter. Resistance to alkali and acid corrosion is high. . . . The biggest selling points of Ethoxyline resin adhesives are their low temperature and low pressure bonding characteristics. Room temperature and the contact pressure of the parts alone are all that is required in many cases.

> A commercial de-enameling plant has been set up to salvage defective pieces for enamel ware manufacturers not equipped for de-enameling. . . . A new process is used and the operation is on a full scale production basis. High production and the high price of steel make the plant pay. . . . A 300 F caustic soda solution does the stripping.

See page 7 for "Materials Control Orders"

Materials Control Orders

A summary highlighting actions of the NPA affecting engineering materials during the period from August 11, 1951 through September 10, 1951.

CONTROLLED MATERIALS PLAN

Dir. 3 to Reg. 1—Manufacturers whose allotments of carbon steel are equal to, or more than, a carload lot may order in full carload lots even should the amounts exceed their monthly permitted amounts. No manufacturer may order in excess of 35% of his total current quarterly allotment of a controlled material for delivery in any one month. He may order up to 50% of his advance quarterly allotment for delivery in any one month because this allotment is only a percentage of the current one.

Dir. 6 to Reg. 1—Manufacturers of class A products may now ask customers for allotments of controlled materials needed to fill the customers' orders only if such allotments will not overstock their inventories beyond the permitted limits.

Reg. 1, Amendment 3—Manufacturers having controlled materials or class A products they cannot use for permitted purposes may hold them for use in other permitted schedules or seek permission to resell them. Those asking instructions for the disposition of such materials must abide by the instructions.

Dir. 3 to Reg. 3—Unrated orders for controlled materials accepted by producers for delivery during the fourth quarter were given equal preferential status with authorized controlled materials orders until Sept. 10. After that date all such orders must have been converted to authorized controlled materials orders.

ALUMINUM (Order M-5)

Producers are required to set aside percentages of their production for automobile and consumer durable goods producers in the fourth quarter. They must also cancel unrated orders which, up to Sept. 10, had equal status with authorized controlled material orders and NPA directives. They may accept or reject any authorized controlled material order and schedule their orders as they wish up to 15 days prior to the expiration of lead times when all such orders must be accepted, with certain exceptions.

BISMUTH (Order M-48)

As of Sept. 1, use is permitted up to 100% of average monthly consumption during 1st six months of 1950, or 100 lb, whichever is greater. Permitted uses expanded to include electrical contact mediums in electrolytic cells, alloys of not more than 10% bismuth for coating cable and wire, and sealing of pit holes on galvanized surfaces due to welding. Inventories increased to minimum 45 day supply.

COPPER (Order M-11)

Producers must set aside percentages of their production for automobile and consumer durable goods manufacturers in the fourth quarter. They must also cancel unrated orders which, up to Sept. 10, had equal status with authorized controlled material orders and NPA directives. They may accept or reject any authorized controlled material order and schedule their orders as they wish up to 15 days prior to the expiration of lead times when all such orders must be accepted with certain exceptions.

As of Oct. 1, a new procedure for allocating available supplies of copper raw materials to brass and bronze foundries was effective for the fourth quarter. Foundries have been classified as small, medium, large minor and large major. Small users must apply for materials on a six-month basis, medium users on a three-month basis and both categories of large users on a one-month basis.

MAGNESIUM

Proposed order will control acceptance and scheduling of defense orders for magnesium, its alloys and products. Producers will be required to allot a specified portion of their production to meet defense requirements. Other provisions would (1) make output of Government-owned plants available only for defense orders; (2) establish a 60-day lead time for placing orders; and (3) provide for NPA assistance to those users unable to place orders with normal sources of supply due to provisions of the order.

MOLYBDENUM (Order M-81)

Allocations of molybdenum, including powder, ingot, wire, rod or sheet, and excluding ores, concentrates, chemicals and compounds, and scrap molybdenum metal must be authorized by the NPA. Use of molybdenum prohibited where substitution of another substance is feasible. Inventories are limited to 60-day requirements.

SELENIUM

As of Oct. 1, a new method of allocation is supposed to be in effect to provide a more equitable distribution of existing supplies. With present sources, however, there is not enough high grade selenium to go around.

IRON AND STEEL (Orders M-1, M-25, M-80)

M-80 supersedes orders M-3, M-10, M-14, M-30, M-33, M-49, M-52 and parts of M-1 in covering the complete allocation of nickel, cobalt, columbium, tantalum, tungsten and molybdenum. It also establishes controls over boron, calcium, chromium, manganese, silicon, titanium, vanadium and zirconium. All are alloying elements for steel and melters or processors of these metals must submit melt schedules to the NPA. Permissible uses of the completely allocated materials are listed in individual schedules for each material. Importation of these materials permitted so long as their use, upon receipt, follows the stipulations of the order. Inventories limited to 45-day supply. Materials processed to some degree but not incorporated into a finished product must be included in the inventory calculation.

Steel producers must set aside percentages of their production for automobile and consumer durable goods manufacturers in the fourth quarter. They must cancel unrated orders which, up to Sept. 10, had equal status with authorized controlled material orders and NPA directives. They may accept or reject any authorized controlled material order and schedule their orders as they wish up to 15 days prior to the expiration of lead times. Then all such orders must be accepted barring certain exceptions.

Amendment to M-25, intended to provide greater flexibility in production of tin cans, limits use of cans according to their uses. Users of lighter weight tin plate than formerly permitted to apply materials saved to production of additional cans.

RUBBER (Order M-2)

Controls on consumption of natural rubber latex and inventories of tires and tubes are eliminated along with the use of the formula employed by manufacturers in applying for allocations of additional rubber to fill priority orders. Inventories of natural rubber extended to 60-calendar-day supply and a 30-working-day supply for synthetic rubber. Specifications for items in Schedule A tightened to minimize consumption of natural rubber.

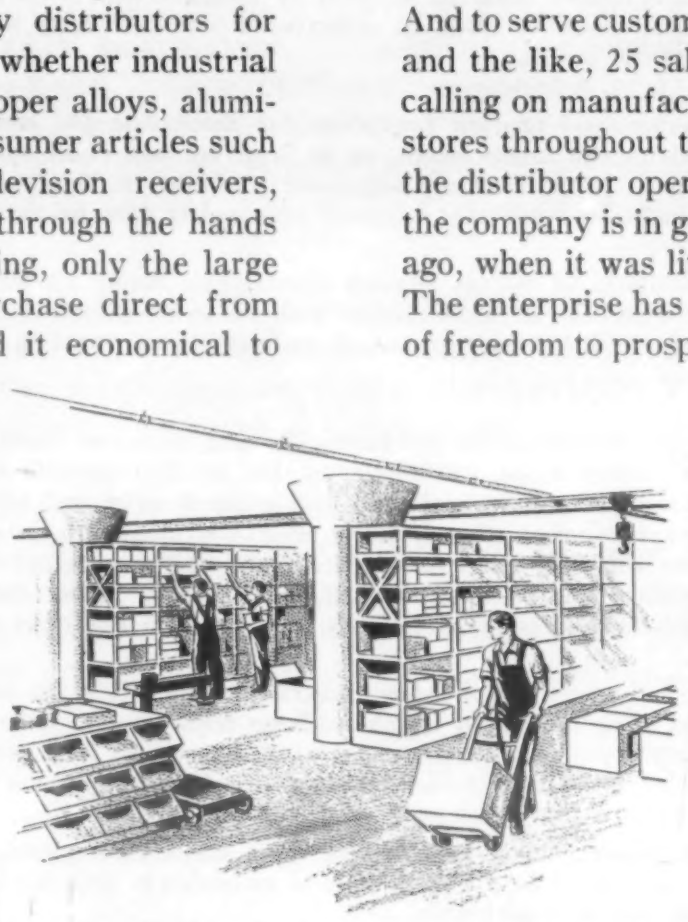
TUNGSTEN (Order M-81)

Allocations of pure tungsten, including powder, ingot, wire, rod, sheet; chemicals and compounds, or carbon reduced powder, and excluding ores, concentrates and scrap must be authorized by NPA. Use of tungsten prohibited where substitution of another material is feasible. Exemptions from prohibitions are: manufacture of pigments for use: In Government currency, securities, and stamps, printing inks, in compliance with NPA directives and where no more than 50 lbs is required in any three-month period. Use in manufacture of any pigments not specifically mentioned is prohibited. Inventories limited to 60-day supplies.

BUSINESS IN MOTION

To our Colleagues in American Business ...

The fact that a Revere Distributor is now celebrating its 125th anniversary year is an indication of the service the company has given its customers through those years. It is also another proof of the essential function performed by distributors for American industry. Most goods, whether industrial materials such as copper and copper alloys, aluminum alloys, iron and steel, or consumer articles such as refrigerators, radio and television receivers, kitchen utensils and ranges, go through the hands of distributors. Generally speaking, only the large buyers are in a position to purchase direct from manufacturers, who do not find it economical to handle the smaller orders. Yet those orders when pooled in the hands of an organization set up to handle them attain sizable totals, and hence a good distributor account is exceedingly attractive to a large manufacturer such as Revere.



A distributor serves not only the factories from which he buys. He also performs an invaluable service to his customers by making quickly available to them the products they require. A machine shop, for example, may need only a few hundred pounds of brass rod; there is a distributor within easy reach who can furnish it almost immediately. Or a contractor may want a few pieces of steel pipe and a thousand feet or so of copper water tube. Again, the distributor has them. A metal products distributor has to carry such items and an infinite number of others. The Revere Distributor who started in business 125 years ago actually has in stock 53,000 different items, cataloged, indexed, and held in warehouses ready for immediate shipment throughout its territory. Each month this stock is drawn upon by 5,000 to 8,000 customers, each order relatively small. There are many Revere Distributors with similar stocks and offering equal service.

To keep this distributor's warehouses filled with a balanced inventory, 18 people are required in his purchasing staff, which includes specialists in various kinds of materials, machines, tools and supplies. And to serve customers with information, quotations and the like, 25 salesmen are on the go constantly, calling on manufacturers, contractors, builders and stores throughout the busy industrial area in which the distributor operates. The large business done by the company is in great contrast to that of 125 years ago, when it was little more than a hardware store. The enterprise has grown in the American tradition of freedom to prosper in accordance with the principles of reliability and efficiency, fair dealing and integrity in performing a desired function.

Revere Distributors are selected for their ability to serve, and also chosen as to location, so that no matter where you are in this big country of ours, there is a Revere Distributor within easy reach. Today metal stocks may be short due to defense demands but manufacturers are doing everything possible to keep distributors supplied.

If you buy from distributors we suggest you remember that they are not only "central stockrooms," but have a great deal of special knowledge about the products they sell and can give you much helpful advice. Not only that, through the Revere Distributors you can be put in touch with the Revere Technical Advisory Service, which will cooperate with you on matters concerning the selection and fabrication of the Revere Metals. Our distributors, and those of every other manufacturer, render many essential services, both to those to whom they sell, and to those from whom they buy. The distributor system as it operates in the United States arose in response to the need for it. Today it fulfills that need more effectively than ever before.

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News Digest

"Let's Get in the Scrap" Drive Gets Results

With the steel industry operating above rated capacity, the demand for scrap steel has increased to the point of becoming a national emergency. Lyon Metal Products, Inc., Aurora, Ill., responded to the call with an intensified scrap collection drive that got results almost immediately.

Lyon's scrap drive had two purposes. First of all, the company wanted to get all of its employees behind the drive, so that they would collect every pound of scrap that could be found around their homes. Secondly, Lyon wanted to put the company itself into the steel industry's effort. The plants were combed over carefully to dig up every pound of scrap, over and above the daily production scrap.

A committee was set up to push the drive. The chairman was the manager of production. The other departments represented included Advertising and Promotion, Personnel and plant superintendents.

This committee took over the promotion program. The first news the employees got of the drive was an insert that went into every pay envelope. This was followed up shortly with an announcement of the drive and a description of its objectives in a company newspaper. A letter from the company president to all the executives, department heads and foremen instructed them to pass the story on personally to all their personnel. A two-color letter, together with a card to be turned in to Personnel indicating how much scrap they had available, was mailed directly to each employee. Signs were placed over all entrances, the town radio made announcements, and new bulletins were put up on bulletin boards periodically A number of stories were also given out to the Aurora newspaper. The final stunt was a sound truck at the plant gates, with girls passing out cards to all employees.

The campaign began to get results within a day and a half after its start. In that time, over 20% of the employees turned in cards indicating they had scrap available. Over 80,000 lb of scrap were credited to Lyon employees, and there is more to come.

There was one more important angle to the campaign. The newspaper and radio publicity prompted over 50 citizens of Aurora to call and inquire how they could participate in the drive and arrange for calls at their houses to pick up scrap. One old lady came to the house of an employee with a heavy Civil War sword to add to the Lyon drive. A cemetery phoned Lyon and asked that a scrap truck make a call. The pickup was 3200 lb, including an old casket.

A company supervisor talks over Lyon Metal Products' scrap drive with a local scrap dealer. Big promotion payed off for Lyon.

G-M Experimental Model Points to Automobile Materials of the Future

The experimental automobile Le Sabre, built by General Motors' Styling Dept. and operated as a laboratory on wheels, contains some interesting departures in materials. Le Sabre has an aluminum alloy skin, a floor of aluminum sandwich material, a box-type frame of chromium-molybdenum steel, an aluminum radiator, a cast magnesium deck lid, rubber torsion-type front suspension, a cast magnesium fender valance, and a cast magnesium lock pillar.

Admittedly, the car is not being considered as a production model It must be remembered, however, that many of the features first tried in General Motors' 1938 experimental car later became standard in the industry. The automotive industry won't switch to aluminum sheet

(Continued on page 10)

for bodies, magnesium castings for ornamental and structural members, sandwich floor, and other innovations in the near future, but it would be surprising if the industry didn't give increased consideration to lightweight construction, with some of these materials finding increasing use in automobiles.

Aircraft, trucks and busses, where weight saving pays big dividends, have led the way, and the passenger car will follow as soon as the economics of materials, and the demands of the car-buying public, shall demand it.

Metal Finishing Papers Presented at the Electroplaters' Society Meeting

The American Electroplaters' Society Convention in Buffalo, July 30 to Aug. 2, heard a number of papers on metal finishing. Most of the discussion centered on electroplating, of course, but the outside topics discussed included metal cleaning, phosphate coatings for metals, and soluble rust preventatives.

Electroplating zinc-base die castings was covered thoroughly. The requirements of these castings for successful electroplating was discussed by Glenwood J. Beckwith, of Metallon Products, Inc., Los Angeles. It was pointed out that die castings suitable for electroplating can only be produced with due regard to the design of the part, the design of the die, the foundry casting technique, and the composition of the zinc alloy. The effects of each of these factors and the precautions that must be followed were explained.

The preparation of the castings for electroplating was described by Earl W. Arnold, of L. H. Butcher Co., Los Angeles. The precleaning, electrolytic cleaning and the acid dip or etch was explained. M. R. Caldwell, of the Doehler-Jarvis Corp., Grand Rapids, Mich., presented a paper on the mechanical finishing of die castings prior to electroplating. He pointed out the necessity for such finishing and covered the methods that are employed, with the procedures and tolerances used with each. The actual electroplating of zinc-base die castings was discussed by Chester G. Borlet, of United Chromium, Los Angeles. The controls necessary to meet specifications were described, and the solution variables and the external variables were discussed.

Research work on metal cleaning was the subject of two other papers. H. B. Lindford and E. B. Saubestre, of Columbia University, described a special specimen and a new procedure for evaluating tests for degreasing processes. The new technique is claimed to be more sensitive than previous tests. E. T. Candee, of The Lea Manufacturing Co., Waterbury, Conn., described the research now being done by the Society on metal cleaning. He gave the reasons behind choosing the problem of finding testing methods for evaluating the cleanliness of surfaces.

Arnold W. Ackerman, of the F. E. Anderson Oil Co., Portland, Conn., presented a paper on rust preventatives. He discussed the types of these materials that are available, classifying as a rust preventive any metal finish that is easily removable with a cheap solvent. The surface preparation and the factors governing the choice of a rust preventative were discussed and the methods used to test the coatings were described.

The possibilities and problems of organic coatings in metal finishing were the subject of a paper by Donald R. Meserve, United Chromium, Inc., Carteret, N. J. The use of clear lacquers or synthetics to supplement metallic finishes was stressed. Particular attention was paid to the acrylic alkyd - urea - formaldehyde and the melazune - formaldehyde - alkyd resin combinations.

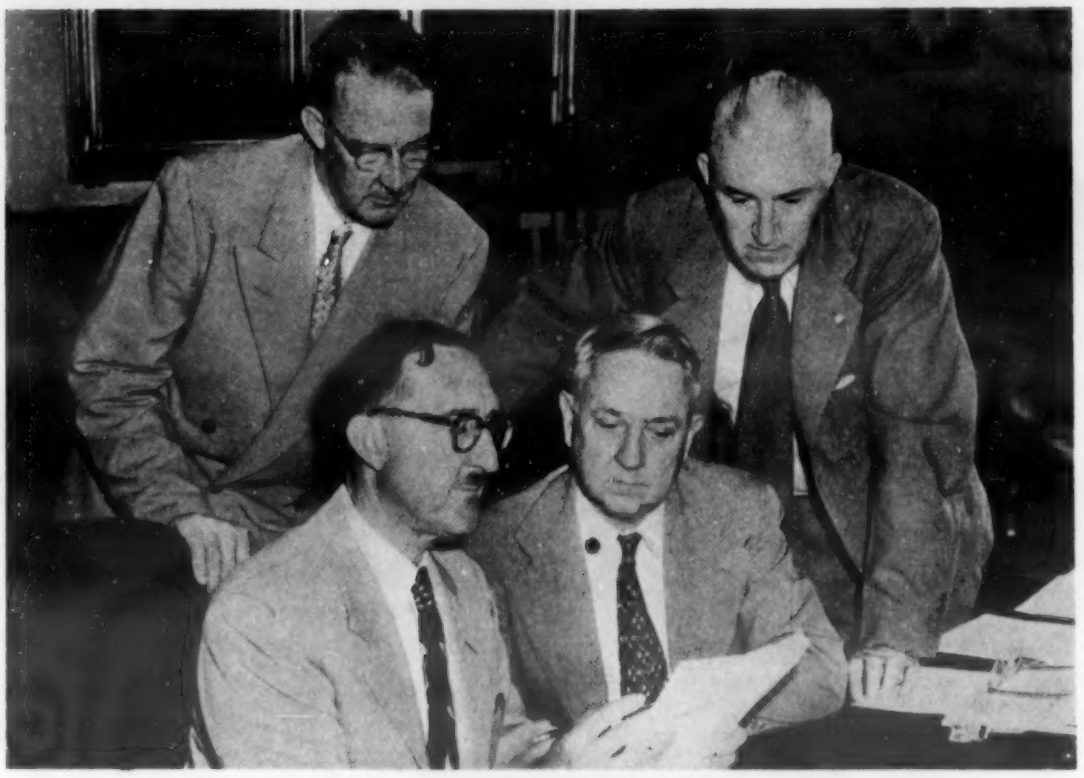
Phosphate coatings, chromate treatments and black oxide coatings for metals were discussed in other papers. Alfred Douty, of the American Chemical Paint Co., Ambler, Pa., described the types of commercial phosphate coatings and compared the applications of electrodeposits to those of phosphate coatings. Chromate treatments and their applications were catalogued by Charles W. Ostrander, Allied Research Products, Inc., Balti-

(Continued on page 13)

Production for Defense Is Theme of 1951 Metals Show

The 33rd National Metal Congress and Exposition will be held simultaneously with the 1st World Metallurgical Congress during the week of Oct. 13 to 19 in Detroit. The technical meetings will be held at the following places: American Society for Metals—Hotel Statler; American Welding Society—Book-Cadillac Hotel; Institute of Metals Div., American Institute of Mining and Metallurgical Engineers — Detroit-Leland Hotel; Society for Non-Destructive Testing—Hotel Detroiter; World Metallurgical Congress—Hotel Tuller; National Metal Exposition—Michigan State Fair Grounds. The purpose of the Congress is "to bring together the experience, the knowledge and the means for a more effective use of metals through engineering and, through conservation and substitution, to insure an adequate supply of materials and material combinations for the strengthening of defense and the preservation of our security."

Approximately 350 nationally known firms engaged in either the production of metals, the treatment of metals, their fabrication, or in rendering services to all of these will exhibit (see page 15 for "List of Exhibitors"). The exhibit space will include 286,886 sq ft of floor space —6½ acres. In addition, thousands of square feet of floor space will be utilized for special meetings, forums, lectures and other activities of the National Metal Congress, the National Metal Exposition and the World Metallurgical Congress.



Walter E. Jominy, ASM President, Dr. James T. MacKenzie (right), Thomas G. Digges and Ralph L. Wilson (standing) plan for World Metallurgical Congress.

Technical Sessions

The four sponsoring Societies, through their scheduled seminars, lecture sessions and meetings on technical subjects pertaining to metals production, treating and processing, will provide the National Congress, National Exposition and the World Metallurgical Congress visitors with daily opportunity to hear vital technical subjects discussed and analyzed by some of the world's leading engineers and teachers. The American Society for Metals and the American Welding Society will hold morning, afternoon and evening sessions throughout the week of the Congress and Exposition. The Institute of Metals Div. of the American Institute of Mining and Metallurgical Engineers will hold daily and evening sessions Monday through Wednesday. The Society for Non-Destructive Testing will hold sessions four days of the Congress week.

The ASM will hold a seminar on metal interfaces, with sessions devoted to theoretical considerations, interface energies, movements of interfaces, and the effects of interfaces. The ASM educational lectures will cover residual stress measurements and the principles of heat treatment. The ASM technical papers will be presented in sessions on constitutional diagrams, melting and refining, diffusion, high temperature alloys, mechanical metallurgy, embrittlement, high temperature phases, heat treatment, physical metallurgy.

The technical papers of the American Welding Society will be presented in sessions covering structural welding, resistance welding, weldability, nonferrous welding, ship structure, arc welding, hard facing and flame hardening, pressure vessels, production welding, gas cutting, welding and brazing, stainless steel, metallizing and inert-arc welding.

The Society for Non-Destructive Testing will hold sessions on magnetic particle inspection methods, radiographic inspection, testing of jet engine parts, and of ordnance material.

The Institute of Metals Div. of the AIME will sponsor sessions on grain growth and recrystallization, alloy systems, transformations, light metals and creep, in addition to two seminars on dislocations in metals.

Awards

Presentation of three top awards will be a feature of the annual dinner of the American Society for Metals, to be held on Thursday, Oct. 18th at the Hotel Statler. The Sauveur Achievement Award, established by the American Society for Metals in 1934, will be presented in 1951 to Dr. Robert F. Mehl, the Department of Metallurgy, Carnegie Institute of Technology, Pittsburgh, Pa. The purpose of this award is to recognize pioneering metallurgical achievements which have stimulated organized work along similar lines to such an extent that a marked basic advance has been made in metallurgical knowledge. Dr. Paul D. Merica, Executive Vice President, The International Nickel Co., Inc., New York, is the 1951 recipient of the American Society for Metals' Gold Medal, recognizing outstanding metallurgical knowledge and exceptional ability in the diagnosis and solution of diversified metallurgical problems. The 1951 ASM Medal for the Advancement of Research will go to Gwilym A. Price, President, Westinghouse Electric Corp.

For "List of Exhibitors," turn to page 15

News Digest

Metal Finishing Papers

continued from page 10

more, Md. Black oxide coatings, their purposes, the metals they are applied to, their advantages and their limitations were covered in a paper by Walter R. Meyer, of Enthone, Inc., New Haven, Conn.

Hot-Hardness Tester Designed by Bureau of Standards

A microhardness tester for measuring the hardness of electrodeposits at elevated temperatures has been developed by Dr. Abner Brenner of the National Bureau of Standards. The new apparatus is based on the diamond-indentation method now used to measure the high-temperature hardness of bulk metals. However, because of the relative thinness of electroplated coatings and their softness at high temperatures, the device has been especially designed to make indentations of microscopic depth under very low loads. Other advantages over previous instruments should also make the tester of value for determining the hot-hardness of bulk metals; in particular, it is expected to find important application in studies of the properties of new types of high-temperature alloys.

In adapting microhardness testing to high temperatures, it was necessary to use a closed system with an inert atmosphere in order to prevent oxidation of the specimen. Otherwise, the diamond indenter would have to indent a considerable thickness of oxide film before reaching the electrodeposited coating. Also, oxidation occurring after a microindentation had been made would tend to obliterate the impression. Another problem involves the indenter shaft. In order that a light load may be applied accurately, the shaft carrying the indenter must move in a bearing with very little friction. Yet the clearance between the rod and the bearing must be very small to prevent the entrance of air.

These problems were met by using in the tester an inert atmosphere

(Continued on page 184)

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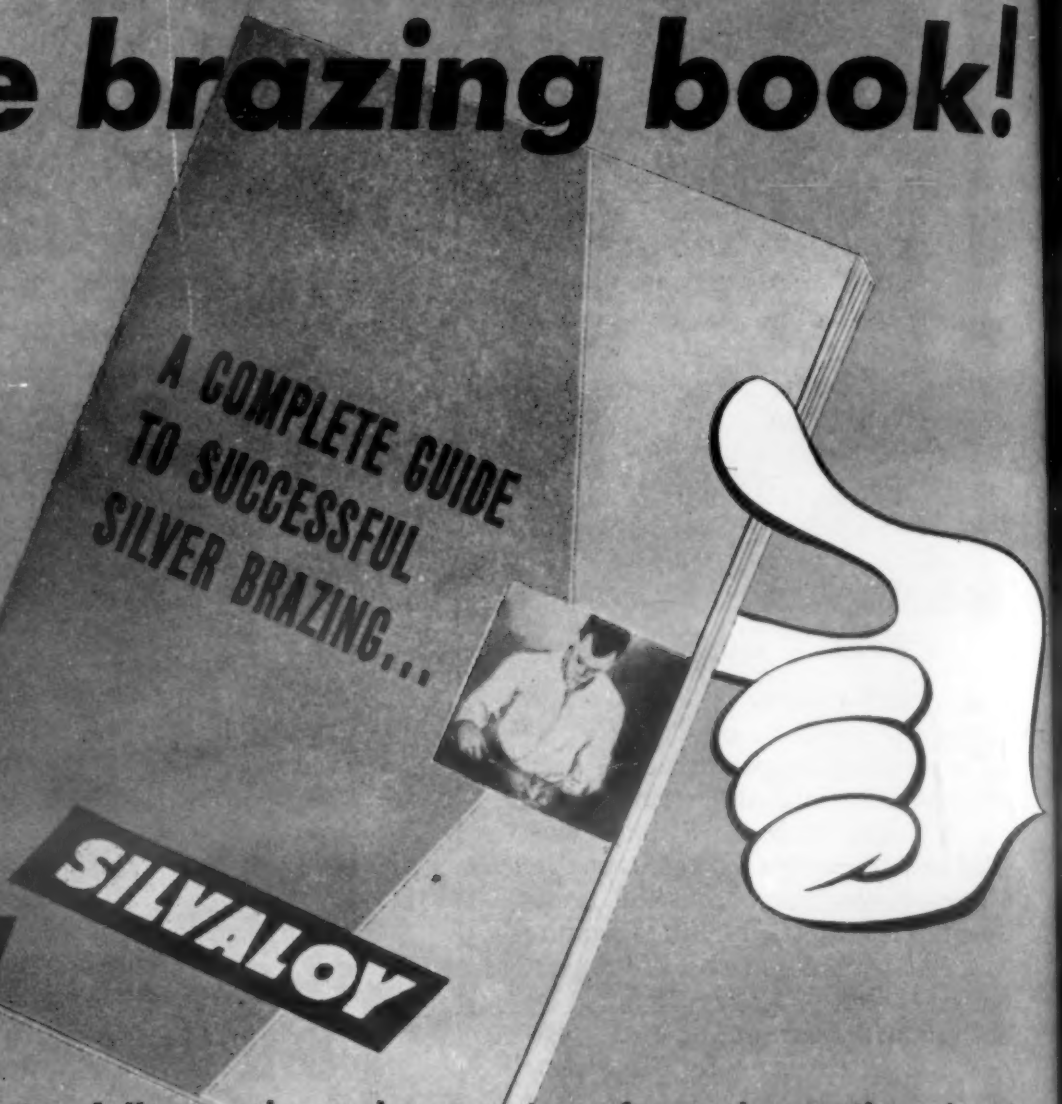

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How to manage moods—electrically

The parts enlarged in the illustration above are a drive gear, a shaft, and panels used in the many types of Superior Electric Company *Powerstats*.

These parts have one characteristic in common. They are all made from Synthane, a laminated plastic.

Superior selected Synthane for its *combination* of properties. Synthane is dielectrically and mechanically strong, easy to machine, and is attractive in appearance. The panels are easily printed at a saving over engraving cost; the gear is silent.

A *Powerstat* is a manager of moods. Installed in the lighting systems of theatres, salons, banks, and other places of business and recreation, a *Powerstat* controls the intensity and blending of light to help create any mood from the spectacular to the subdued, from reverence to revelry.

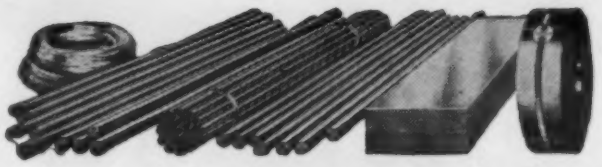
Synthane is made in many grades, each particularly desirable for some electrical, chemical or mechanical purpose. Yet each grade possesses a *combination* of other valuable characteristics. Light weight, mechanical strength, resistance to moisture, corrosion and abrasion, high dielectric strength, low power factor, dimensional stability under a variety of conditions, and ease of fabrication are just a few of them.

Should these properties of Synthane suggest a possible application to you, write for more information. Synthane Corporation, 23 River Road, Oaks, Pennsylvania.

PLASTICS WHERE PLASTICS BELONG

SYNTHANE

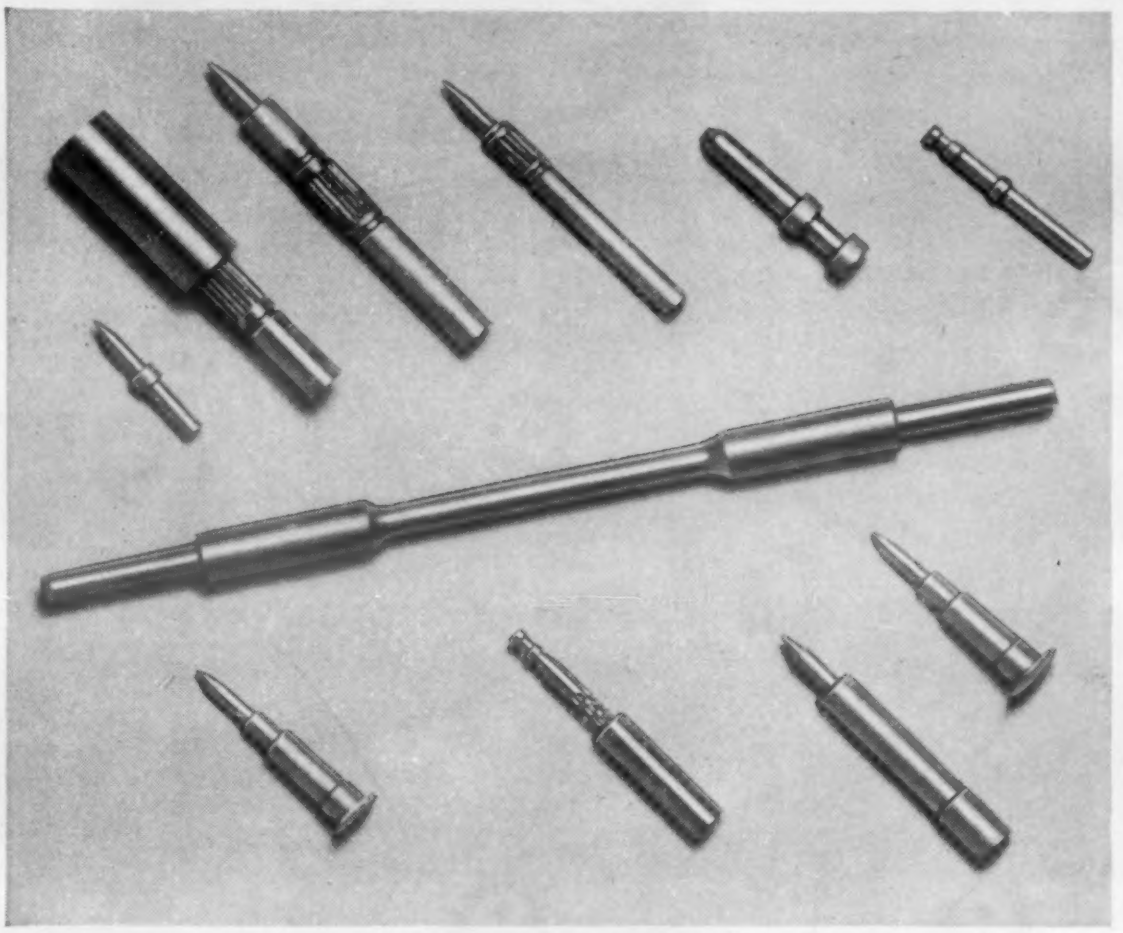
Manufacturers of laminated plastics



BRIDGEPORT BRASS COMPANY

COPPER ALLOY BULLETIN

"Bridgeport" BRASS CO. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



Examples of small parts produced accurately and economically on Swiss screw machines. Tapers on some parts generated on cutoff end to eliminate secondary machining operations. Courtesy Newtown Mfg. Co., Newtown, Conn. *(samples enlarged 35%)*

Taper Generated to Eliminate Secondary Machining Operation

Parts such as firing pins for fuses or electronic terminals with tapered points on one end, as well as operations on the opposite end, are often completed in the primary operation on Swiss screw machines. This is accomplished by generating the point on the cutoff end. Previously, this part was completed in a secondary operation.

In generating a taper, a single-point tool is used. The stock feed cam and the tool feed cam are synchronized to produce the required angle. Since the pressure of the single-point tool is almost negligible when compared to a broad-forming tool, distortion of the part is thereby reduced to a minimum, if not completely eliminated, and smoother finishes are obtained.

Unleaded Brass Used

The part in the lower right corner is a good example of such work. It is made from high brass rod (65% copper, 35% zinc) drawn to a spring temper. Without lead this alloy is generally not used in screw machines as the chip is long and stringy. However, the alloy and temper was used to obtain higher tensile strength and greater wearing qualities.

The overall length is .900 in. with one diameter .135 x 3/16 long, another .120 x ½ and the tapered diameter .065 x 7/32. A .090 drilled hole is put in the .135 diameter.

Drill Edges Rounded Over

The cutting edges of the drill were rounded over to produce a negative rake, thus causing the chip to come out in a long, unbroken curl. In this way clogging by chips was eliminated and drill breakage reduced.

In rounding over the cutting edge of the small spiral drills, it was found that a diamond wheel produced a finer finish which decreased the friction and also produced a cleaner hole. Care must be taken to prevent burring of the cutting edge.

Carbide tools were used on all the parts and only standard twist drills were used rather than the flat gun drill.

The cutting compound used was a heavy sulfur-base oil. The work discolored but tarnish was removed by dipping.

The difficulty of centering accurately prior to drilling was overcome by using a fixed cutting tool from the overhead post. By accurately turning the center, the possibility of the drill walking and breaking was considerably reduced.

A spindle speed of 10,000 rpm was used with a feed of about 0.0009. For a better finish the feed can be reduced to around 0.0005.

Double Feed-Out Utilized

The length of the part in the center of the illustration theoretically was too great for the machine which matches the diameter of 5/32. However, by feeding twice without cutting off and supporting the work from the turret, it was possible to turn the three diameters, then cut off.

In cutting either leaded or unleaded copper-base alloys, no top rake was used and the clearance angles were between 5 and 10 degrees. High finishes were obtained by slightly breaking the edge of the cutting tools.

For information on the cutting characteristics of various alloys and information on machining them, write on company letterhead for Bridgeport Brass "Technical Handbook." If additional help is needed, contact our Laboratory. (7281)

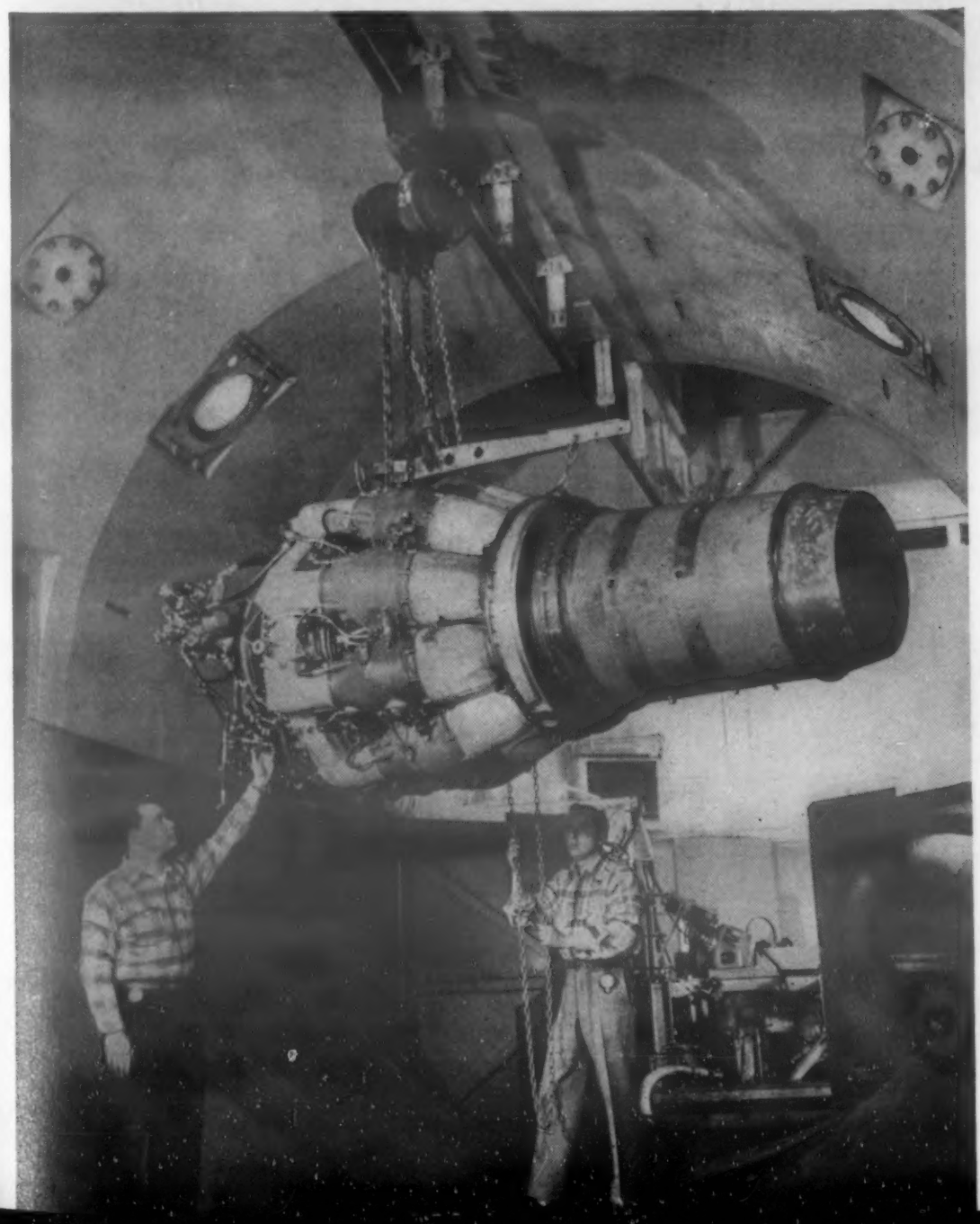
Materials Engineering Plays Important Role in Development of P&WA Jet Engines

—MATERIALS ENGINEERING IN ACTION

The development and production of a turbojet aircraft engine is a large and highly complex job. One of the most important parts of this job is selecting the great variety of engineering materials, parts and forms out of which the engine is made. In addition, testing the materials and selecting the processing methods best suited are vital to the efficient production and dependable performance of the engine.

Today the most powerful turbojet engine being delivered to the U. S. military services by an American manufacturer is the Pratt & Whitney Aircraft J-48 Turbo-Wasp. About 23,000 parts make up the engine, and more than 12,000 special tools are required for its production. Before an engine such as this can be put into full-scale production many thousands of hours of engineering work are required. A large share of the engineering task involves materials engineering in one way or another. After the engine is designed and the stresses and service requirements set up, it is the job of the materials engineering department to select the materials that will meet the imposed requirements. The number of ferrous and nonferrous metals, nonmetallics, parts and forms, and finishes going into a turbojet often totals close to two hundred.

The J-48 Turbo-Wasp, most powerful jet engine being delivered to U. S. military services.

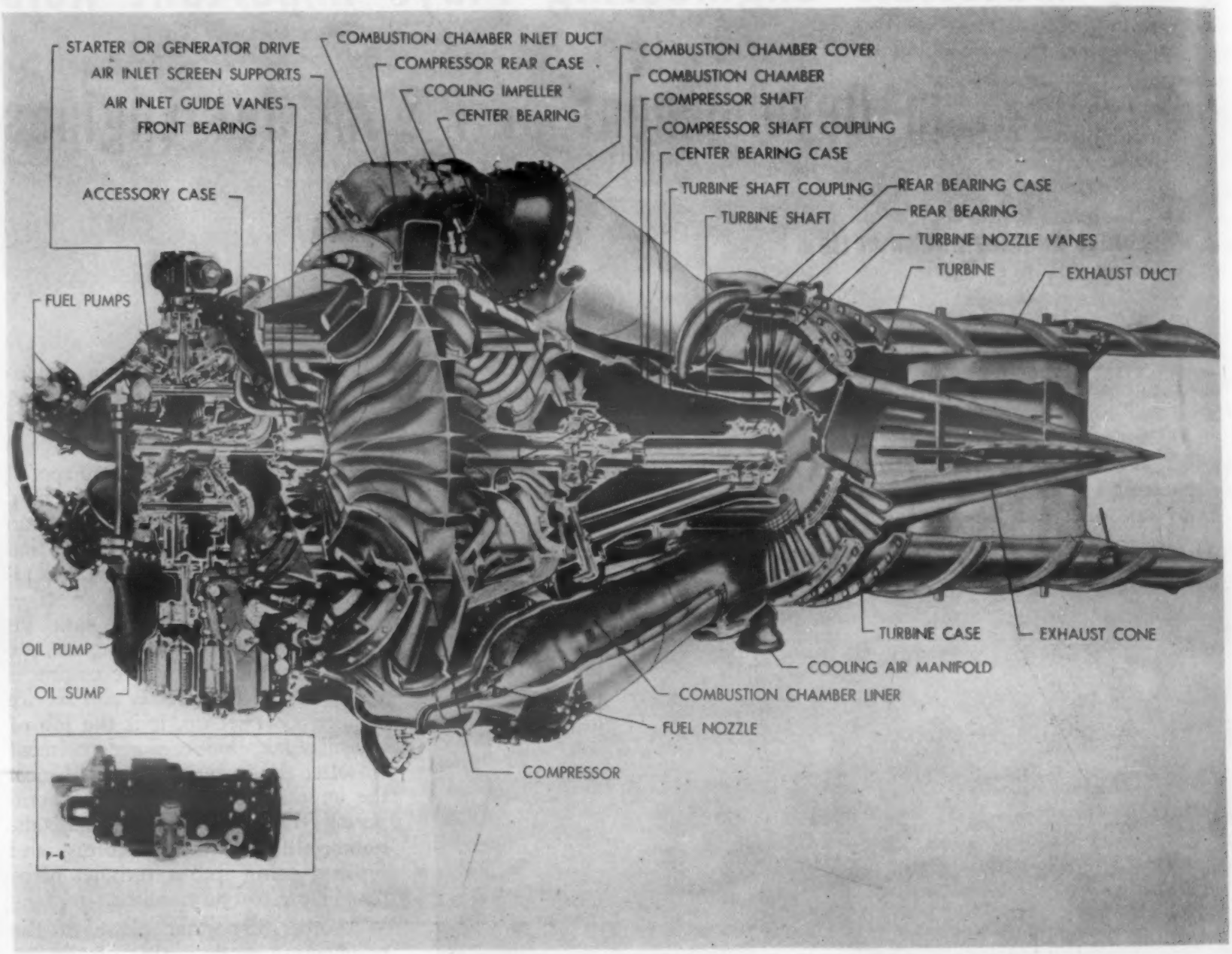


Another important phase of the engineering work is that of the development engineers. Their job is to thoroughly test the early prototypes of the engine and determine what improvements in performance can be gained by changes in engineering materials, design details, and accessories. In addition, they continue to search for better and more economical processing methods. Thus, a large part of the development engineering job on jet engines is concerned with material problems.

On the following pages the engineering materials that go into the making of the J-42 turbojet are listed, along with a brief description of some of the materials processing methods. This jet is of somewhat lower power than the J-48, but similar in basic configurations.

Selecting the Engineering Materials

At least 150 different types of engineering materials go into the making of the Turbo-Wasp jet engine pictured below. This includes 60 irons and steels, 29 nonferrous metals, 10 nonmetallic materials, 35 parts and forms, and 23 coatings and finishes. All these are selected and detailed specifications written by materials engineering department. See detailed breakdown below.



Irons and Steels

26 stainless and heat resistant steels
16 carbon steels
14 low alloy-high strength steels
2 high alloy steels
1 low alloy steel
1 high strength gray cast iron

Nonferrous Metals

19 aluminum and aluminum alloys
5 magnesium and magnesium alloys
2 brasses
3 bronzes

Nonmetallic Materials

6 rubbers—synthetic and natural
3 plastics
1 ceramic

Parts and Forms

14 machine screw parts
5 types of springs
4 sand castings
2 stampings
2 precision castings
2 spinnings
2 molded plastic parts
1 die casting
1 metal powder part
1 aluminum extrusion
1 deep drawn part

Coatings and Finishes

Sprayed aluminum
Anodized coating
Chrome pickle protective coating for magnesium
Plated finishes—cadmium, tin, copper, silver, lead, indium, nickel, chromium
Buffing and polishing treatments
Corrosion preventive coatings—medium film, thin film, high flash slush, heavy plastic, light plastic, bearing compound
Organic Finishes—primers, enamels, corrosion preventive varnish, high temperature aluminum paint

Selecting Methods to Process the Materials

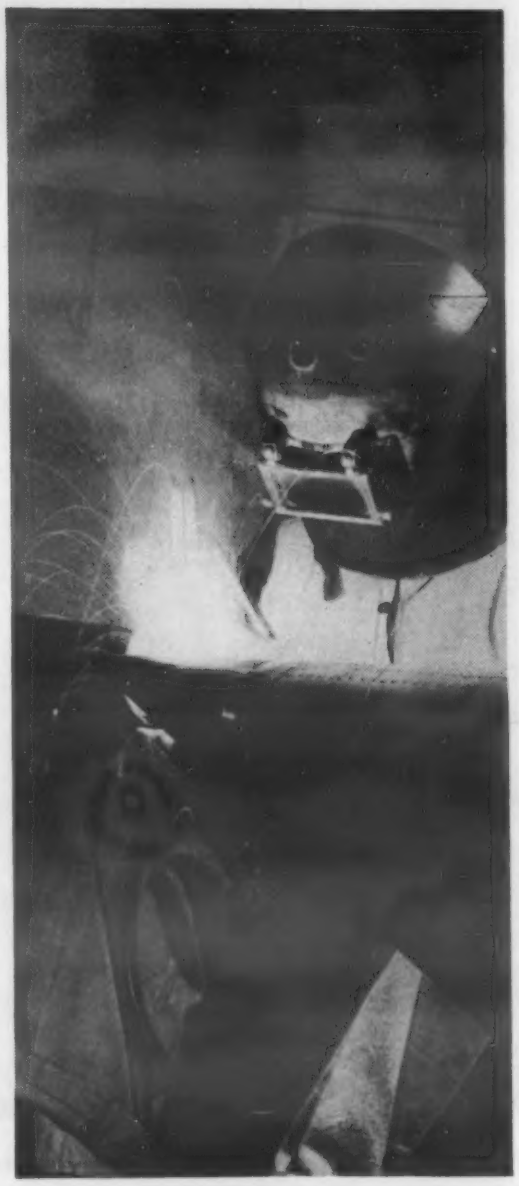
Interrelated with materials selection is the task of determining methods by which the materials can be most efficiently processed into their final form. Among the important processing methods involved in jet engine production are heat treating, joining, and finishing and cleaning.

Heat Treating Operations

Heat treating plays a vital role in achieving the exacting end service properties required of turbo-jet engine parts. At least 25 different heat treating operations are required, involving practically all the common types of heat treating equipment. Some of the typical treatments include hardening low alloy steels, high alloy steels and carburizing grades; carburizing to case depths of 0.015 to 0.30, 0.025 to 0.040, and 0.40 to 0.055 in.; nitriding to case depths of 0.010 to 0.015; tempering; annealing; stress relieving. In addition, cold treatments are used for shrink fitting and tempering operations.

Joining Methods

Besides the use of a variety of mechanical fasteners, considerable amounts of welding are needed to fabricate Pratt & Whitney Aircraft turbojets. Inert-gas-shielded arc welding is extensively used as well as seam and spot resistance welding. Other joining practices include copper and silver brazing, and electric (soldering iron) and gas soldering. Shown here is the steel tip of the tail cone in the exhaust duct being welded by the inert-gas-shielded arc method.



Finishing and Cleaning Methods

The finishing and cleaning methods used on the Turbo-Wasp jet engines are closely related to the coatings and finishes already listed under engineering materials. The list of finishing and cleaning operations include (1) shot peening by air pressure and centrifugal force; (2) anodizing; (3) polishing by at least six different methods to remove burrs, heat treat scale, excess weld metal and for smoothness and color; (4) plating using still tank, semi-automatic and barrel methods; (5) immersion chemical treatments; and (6) mechanical deburring by tumbling for descaling after grinding, after honing, and general deburring purposes.

New Forming Methods Expand Use of Polyethylene Plastics

by KENNETH ROSE,
Western Editor, Materials & Methods

A modified casting procedure, a new joining method and means of applying coatings now permit wider utilization of the polyethylenes' valuable properties, which include high chemical resistance and good heat resistance and dimensional stability at elevated temperatures.

● THOSE PLASTICS COMPOSITIONS called polyethylenes possess many properties that make them valuable to industry for a wide variety of uses. Some of these are very high chemical resistance, good heat stability, and good dimensional stability at elevated temperatures until very close to the melting point. These properties, while valuable from the application standpoint, impose several limitations as to methods of use. The high chemical resistance, for example, makes it impossible to apply the polymer to base materials by solution methods, as the plastic is insoluble in all the commercial solvents at room temperatures. The same factor interferes with the bonding of the polyethylenes by solvent methods.

New forming methods have been developed that utilize the properties of these plastics in a modified casting procedure, a joining method, and a means of applying coatings. The three methods make use of the sharp break in viscosity of the polyethylenes as the temperature reaches a critical value, and its excellent resistance to deterioration by heat. A result of the use of these new methods is that the application possibilities of plastics, and of the polyethylenes in particular, have been greatly expanded. While the procedures are different, they are all dependent upon these special properties of the polyethylenes. Several of them seem to hold possibilities for other plastics families that to some degree approach the polyethylenes in their behavior when heated.

The casting procedure, which has been called spin casting, resembles centrifugal casting of metals in permanent molds, and in its essence is simply the swirling of the highly fluid plastics material in a revolving

Welding polyethylene molded flanges onto polyethylene piping. (All photos courtesy American Agile Corp.)

metal mold. It overcomes some of the size and shape limitations of molding in presses.

The joining method is a means for producing a true fusion weld in plastics, and consists of directing a jet of heated gas at the location to be joined, using a rod of the same material as filler. The coating method is a flame spraying process that closely follows the method used for spraying of molten metal in metallizing. The molten plastic is carried as a spray through a special gun and is deposited onto the metal surface that is to be coated.

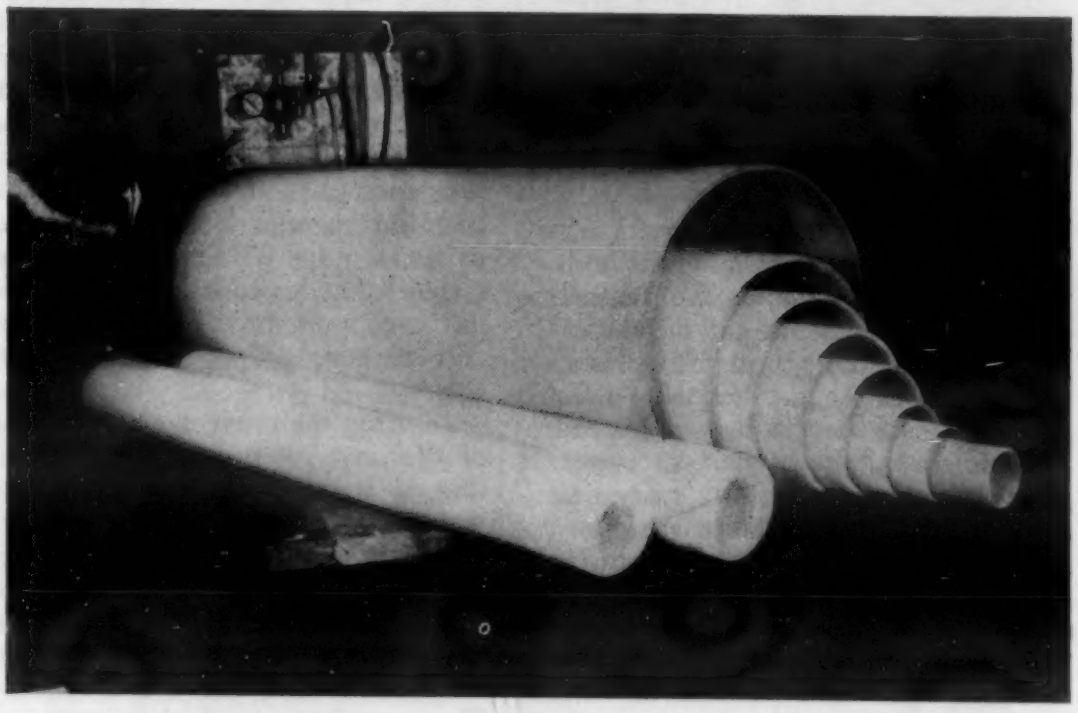
All processes are the outgrowth of work done in England and Germany shortly before and during the war. Wartime developments in Germany were studied by technical observers immediately after the end of the fighting, and the method of fusion welding of plastics used there was afterwards improved and expanded by research here and in England. Four American companies are now promoting the processes, or equipment using them.

Casting Method

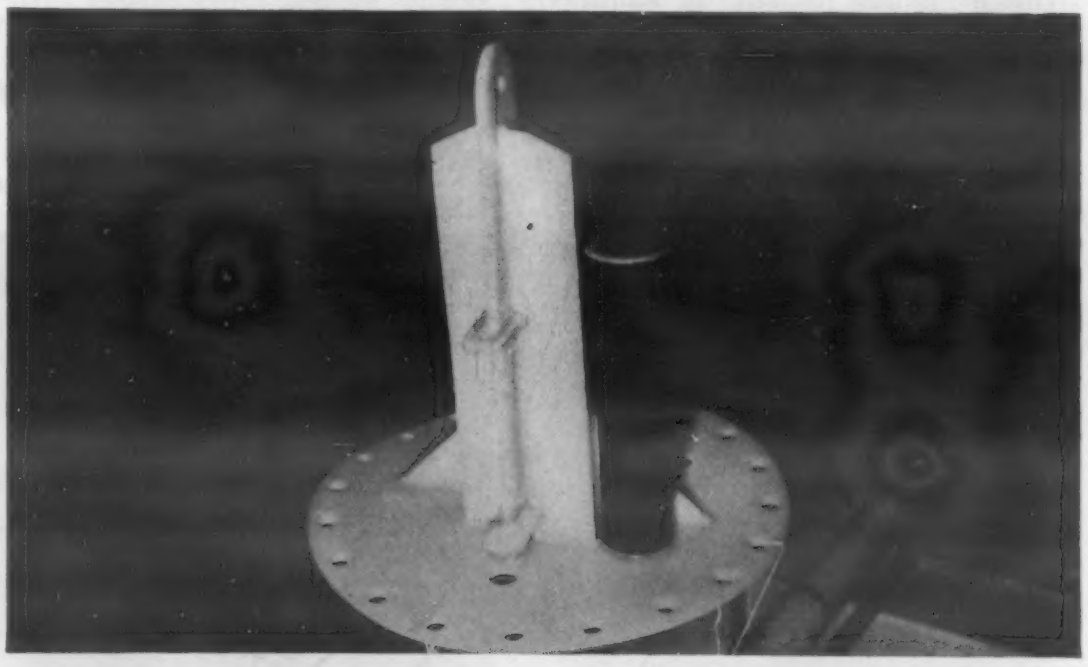
In the spin casting process the molds, of special alloy, are usually used horizontally. They are most commonly simple tubes or cylinders. The granular polyethylene is fed into the tube, which is heated to about 450 to 500 F to fuse the plastics material. The tube is rotated at moderate speed, and then cools to permit the polyethylene to solidify. The piece is then stripped from the mold.

The wall thickness developed by this forming method is quite uniform. It depends upon the diameter of the piece, and can vary from about $\frac{1}{8}$ in. to about $\frac{1}{2}$ in. At present, outside diameters of spin cast pieces range from about $2\frac{3}{4}$ in. to about 22 in.

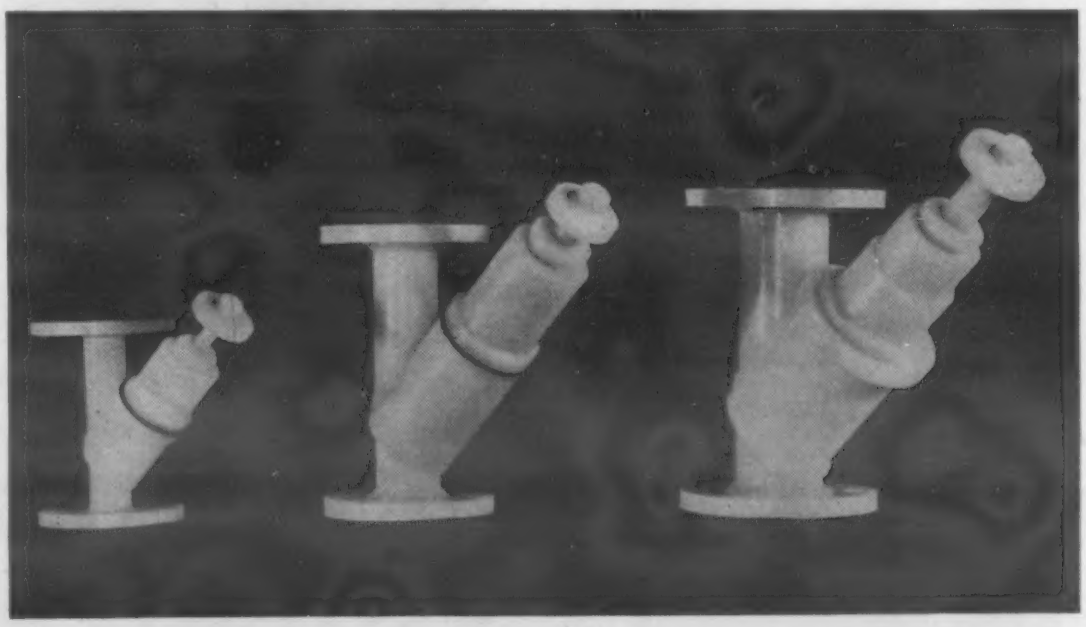
By this process cylindrical pieces of large diameter or long length can be produced economically. Tubing for the chemical industry, body cylinders for large acid carboys, and similar items have been the principal products. The carboys are made by casting the body cylinder and welding tops and bottoms, molded in conventional manner, to the cylinders. As the material is highly resistant to most chemicals, including hydrofluoric acid, the production of piping and containers for the chemical industry is expected to be an important outlet for polyethylenes. Valves can be fabricated of the plastic and welded into the piping



Assortment of cast polyethylene tubing ranging from 2½ in. to 22 in. in dia. On left are examples of heavy wall thickness tubing which can be produced.



This bleach tank manhole cover, 24 in. in dia., was fabricated entirely by welding using a combination of polyethylene sheet, tubing and molded parts.



These valves are made of molded polyethylene sections assembled by hot welding.

systems, and bends, tees and other standard pipe forms can be produced also, thus providing a complete piping unit of high corrosion resistance.

Welding Process

The welding process referred to is another of the new forming methods. It somewhat resembles the familiar gas welding methods for metals, except that in the process for plastics the materials are not heated by direct contact with the gas flame. Instead, the torch becomes a heat exchanger in which the combustible gases heat inert gases, and the latter are blown through a directing nozzle onto a small area of the work. The inert gases can also be heated electrically. A rod of polyethylene is used as filler in the same manner as filler rod is used in welding metals.

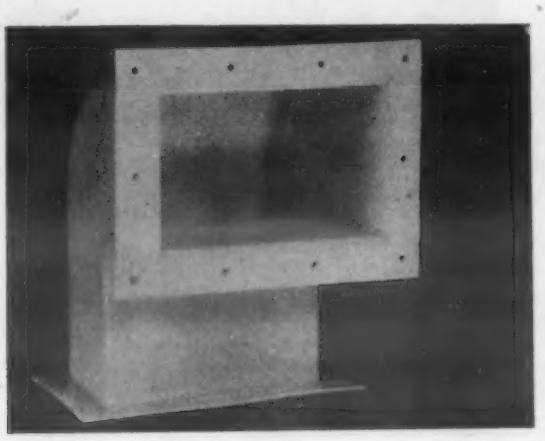
The welding gun consists of a heating chamber through which a coil of tubing, usually of stainless steel, carries the inert gas to a nozzle which directs it upon the work. The inert gas, usually nitrogen, is supplied to the gun through a small hose from a supply tank, and the combustible gas, usually acetylene, is supplied to the heating chamber around the coils in the same way. The electrically heated gun has resistance coils in the heating chamber, and operates from 110-volt d.c. or a.c. supply. The inert gas can be carbon dioxide, and the combustible gas can be a mixture of coal gas and oxygen, propane gas and air, etc.

In using the torch, the rate of flow of the inert gas must be so adjusted that it will heat the work at the weld zone to about 400 F. Heavy workpieces will require a greater flow of gas than light sections, but the flow will usually fall between 10 and 50 cu ft per hr. Various sizes of nozzles are available also. The temperature of the inert gas must be about 100 to 150 F higher at the nozzle to maintain the required 400 F at the work surface. The nozzle should be about 1/8 in. from the work.

Butt, lap or fillet welds can be made with the equipment. The work should be grooved for butt welds, as would be done with metal. Filler rods should be round stock, and about 1/4 in. in dia. The weld may be completed in one pass, or several passes may be required with heavy work. Welding speed will be of the order of 3 to 10 in. per min. A properly made weld will show a strength equal to that of the sheet stock, though fillet welds, in which the molten plastics material does not penetrate the entire abutting area, will usually be weaker.

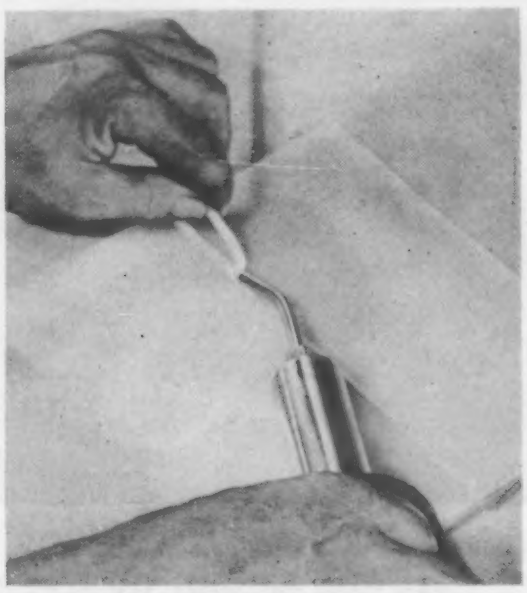
The welding process makes possible the fabrication of plastics pieces too large or too irregular to be molded, using sheet stock and other formed pieces just as in producing weldments in metals. Large carboys for acid storage can be made from sheet stock by rolling the heat-softened sheets into cylinders and welding the longitudinal seams, then welding in molded tops and bottoms. Acid buckets, fume hoods, piping systems, etc., are typical of welded pieces now being produced.

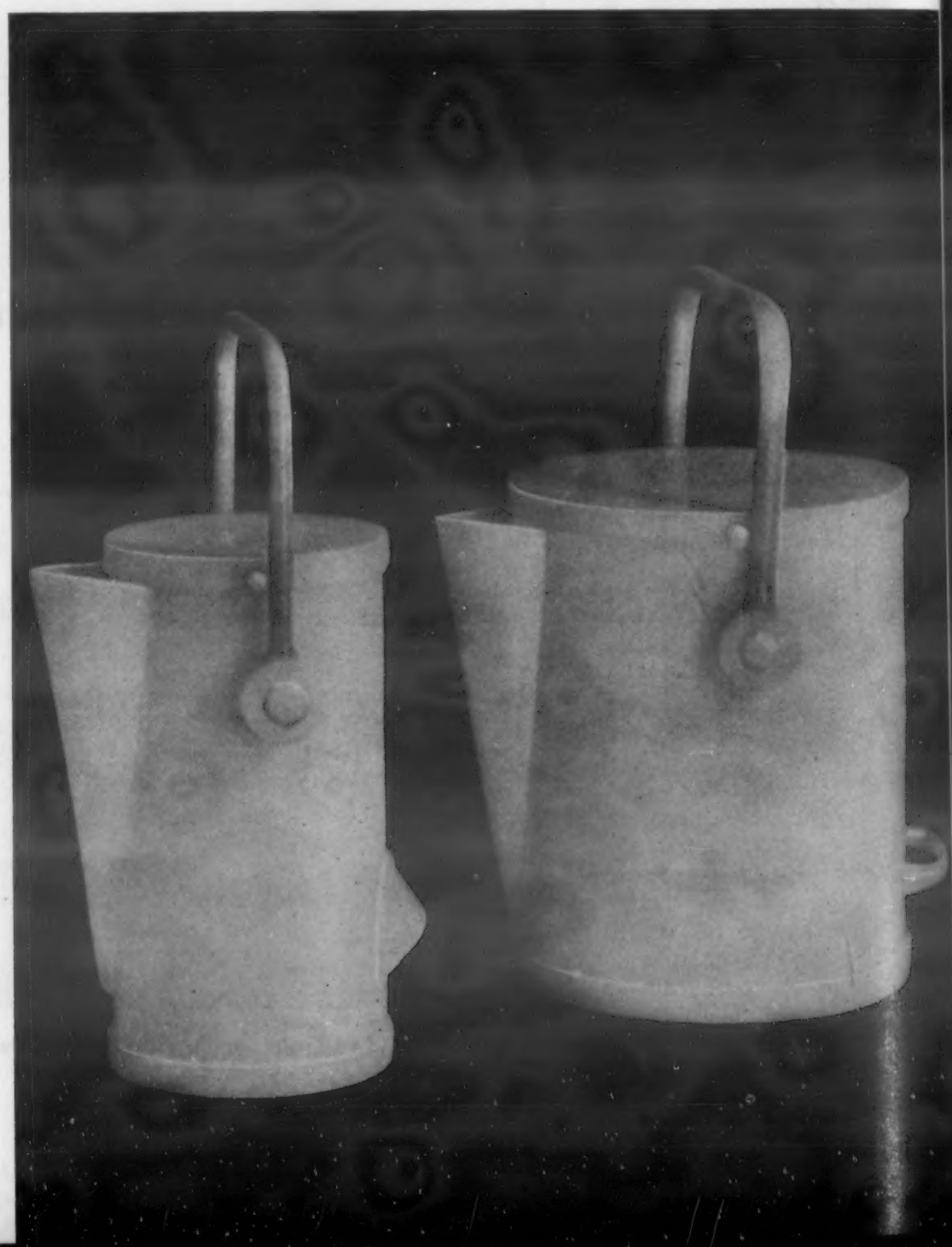
Fabricated rigid polyethylene safety jugs.



Section of fabricated polyethylene duct line, about 10 by 14 in. in cross-section.

Close-up of actual welding operation on butt-weld of polyethylene sheeting.





Flame Spraying

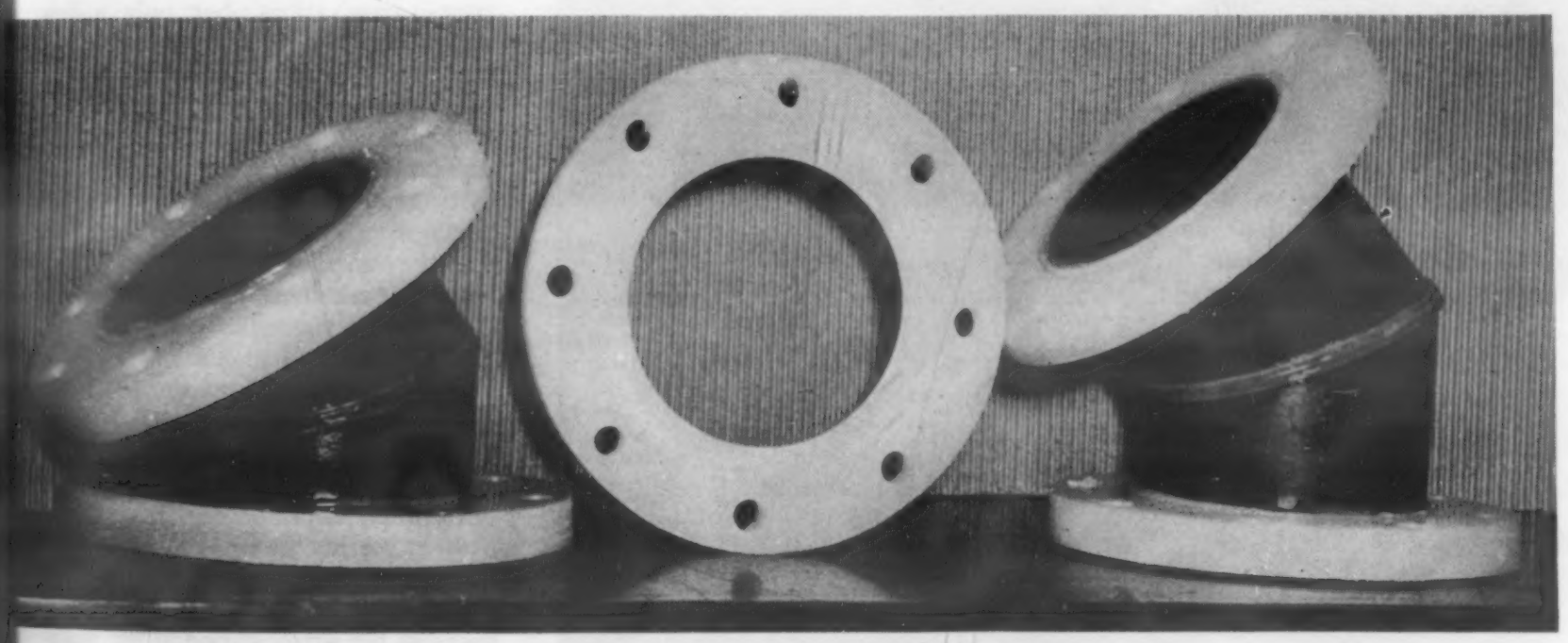
The third method for using molten polyethylene is a process for spraying the fluid plastics material onto a preheated metal surface, providing a coating of high corrosion resistance and good bond strength. A spray torch is used, with acetylene the preferred combustible gas. The polyethylene is supplied as a powder, which sifts through a funnel-shaped hopper vibrated by an air-driven device and is carried on a stream of air to the gun. Here it is carried into the flame for an instant, and with the flame to the preheated metal surface.

In preparation for the spraying operation, the metal surface is first cleaned of all dirt and grease, all scale is removed, and the metal is uniformly roughened. Small areas can be roughened with an emery disk, but larger surfaces are best prepared by shotblasting or sandblasting. Preheating can be done with the spray gun by adjusting it to produce a neutral flame about 3 in. long, or the pieces can be heated in an oven. The work area, or target, should be heated to about 400 F. If a large surface is to be spray coated, about 8 to 10 sq ft should be preheated at a time, if a second gun is available to prevent too-rapid cooling; otherwise, only about 1 sq ft can be preheated. With metals of thicknesses up to about 3/16 in., preheating can be done with the spray torch.

For spraying, the amount of air fed to the flame during preheating is reduced by closing the bypass in the gun, which action also sets up a suction and starts pulling powdered polyethylene into the gun. The length of the flame is increased to about 24 in., but the flame is much cooler than the short flame used for preheating. The powder is partially melted during its passage through the flame, and fusion is completed as it strikes the hot target. The passes should be about 2 in. wide, and should overlap slightly. Passes can be made either horizontally or vertically. About 1/16 to 3/32 in. of coating can be deposited in one pass.

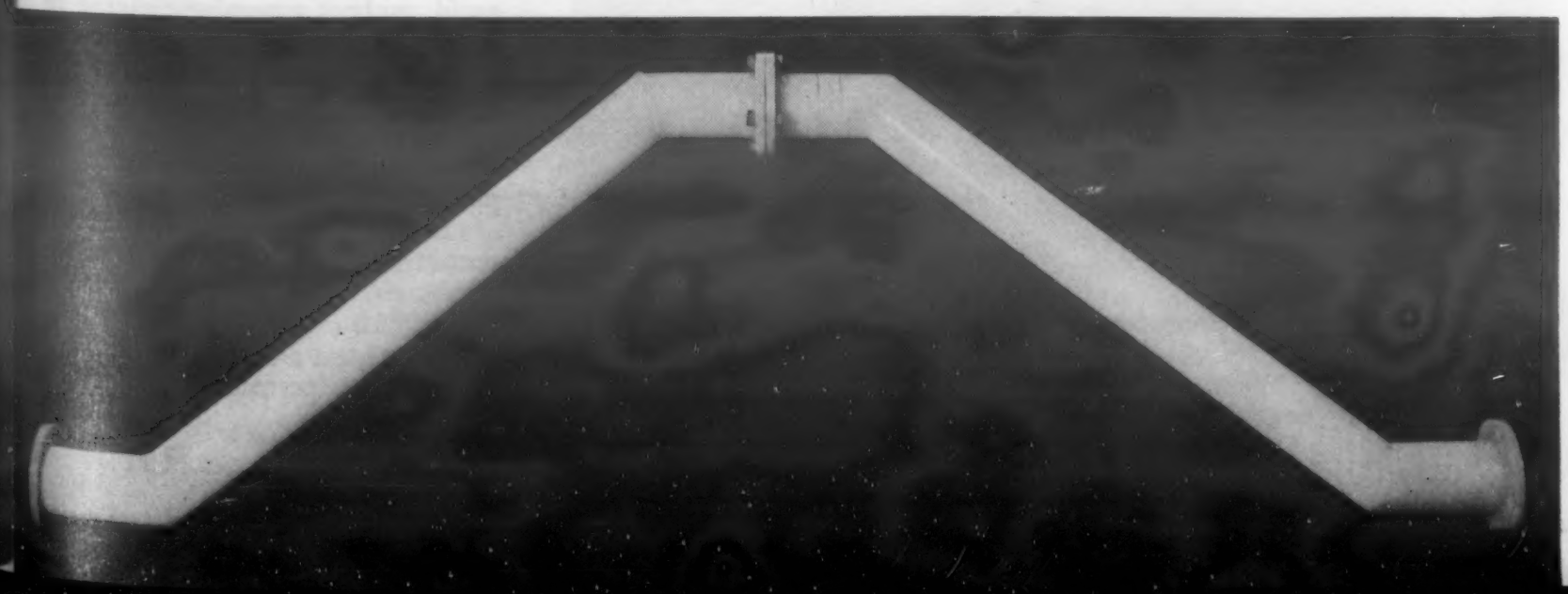
Sprayed tanks are being used in the food industries, and especially by breweries, where fermentation vats may be polyethylene coated. In the textile industry, acid tanks have been spray coated with the polymer. A tank car lined with sprayed polyethylene is now under test to determine whether its performance under all conditions will be satisfactory. Storage tanks and drums are other possibilities for spray lining.

While these processes have been worked out successfully with polyethylene plastics, some of them may be suitable for use with other thermoplastics. Welding by the method described has been used to some extent with polyvinyl chloride, both plasticized and unplasticized. The method seems to promise good results with the unplasticized material, but with the plasticized form the nature of the plasticizer may make results uncertain. Methyl methacrylate polymers have been welded by the hot gas technique, using compressed air as the inert gas, but this work is still in an experimental stage. Flame spraying has been attempted with tetrafluoroethylene, but results here are not yet conclusive.



Welded polyethylene pipe fittings for incorporation into pipeline assemblies.

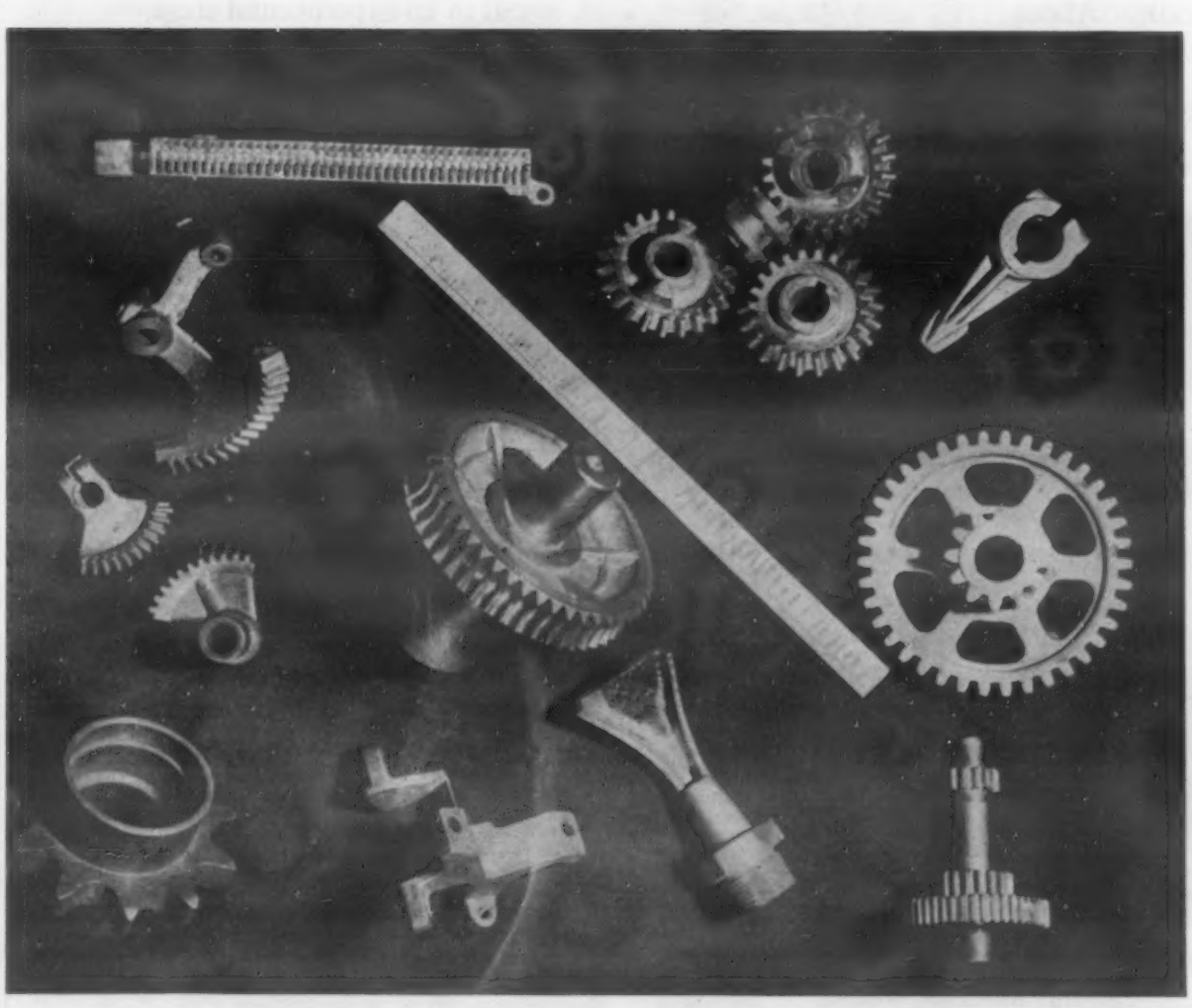
Section of polyethylene pipe line assembly showing flanged connections. Piping shown is cast tubing, flanges are molded, and welded to piping. Bends are welded.



Copper-Base Die Castings Now More Widely Used

The recognized advantages of die cast parts, including close tolerances, elimination of machining, good surface finish, high production rates and good physical properties, are attained by casting copper-base alloys in permanent molds.

by **BEN JOHNSON** and **SIDNEY E. GREGORY**,
Pressco Casting and Manufacturing Corp.



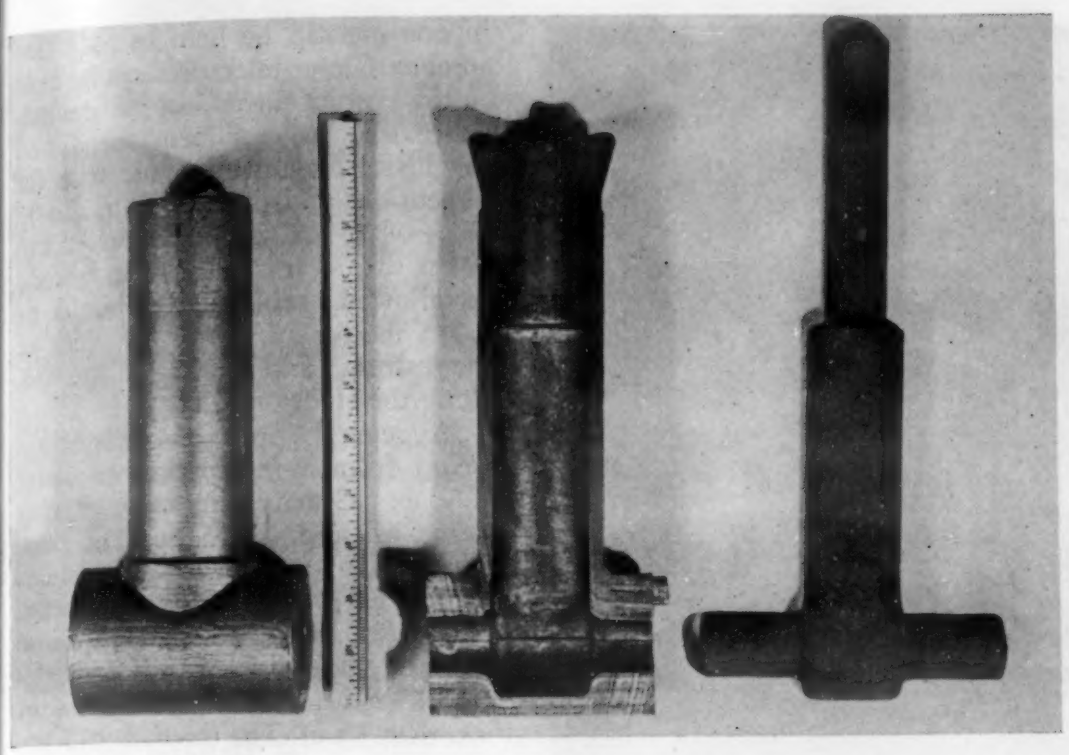
A selection of permanent mold castings made of brass and aluminum bronze. (All illustrations courtesy Pressco Casting and Manufacturing Corp.).

● DIE CASTING IS AN important high-production method for the low-melting metals zinc and aluminum, and for many of their alloys. Magnesium has come into this field in increasing amounts recently, and promises to become one of the standard die casting materials. Zinc-base die casting alloys have melting points of about 700 to 725 F, and the aluminum alloys will melt in the neighborhood of 1100 F. Both of these temperature ranges are such that chambers for molten metal and die casting machine parts in contact with the hot metal can be held at temperatures at which their hardness and strength will not be seriously impaired.

Going up the scale of melting points, the next structural metal is copper. Attempts have been made to adapt the use of permanent molds to copper-base alloys, but only a few companies have found means to make the process commercially successful. Most companies report short die life and mechanical difficulties in the equipment when the pressure die casting of copper alloys has been tried experimentally, and have given up the method as uneconomical. Gravity permanent mold casting has had limited success also. A few die casting plants have successful processes in operation, and Pressco Casting and Manufacturing Corp.'s Chesterton, Ind., plant is one of these.

Casting copper-base alloys in permanent molds offers the usual advantages of die cast parts, in that they can be produced to close tolerances in the original operation, without waste of metal in machining or otherwise working to final form; surface finish is good enough to permit using as the piece comes from the mold, without extensive cleaning or refining; thinner sections can be cast in permanent molds; production rate is high; and physical properties of the metal are good.

A disadvantage in the case of pressure die casting is the tendency of the surface to show pinpoint porosity, which detracts from the finish if the piece is chromium plated. Also, there are fewer alloys being pressure die cast than are cast in sand or permanent molds by



Semi-permanent mold aluminum bronze casting weighing 8 lb (right) made using a sand core (left).

gravity. Copper-based gravity die casting systems are not automatic as are the elaborately mechanized equipment used for most installations with zinc or aluminum die casting, or copper-base pressure die casting. But even with the simplified equipment used for gravity die casting a good rate of production is obtained.

Die Casting Alloys

Cuprous alloys being pressure die cast at Pressco include a general purpose, and a silicon bronze, whose nominal compositions are given in the accompanying table.

The general purpose brass is cast at about 1700 F, but can be used with the metal in a mushy state at 1600 F. The silicon bronze possesses higher strength, and remains in a pasty state over a wide range of temperatures, which gives it preference when pieces of complicated form or when thin sections are to be cast. Casting can be done at temperatures between 1800 and 1650 F, depending upon the characteristics of the piece to be made.

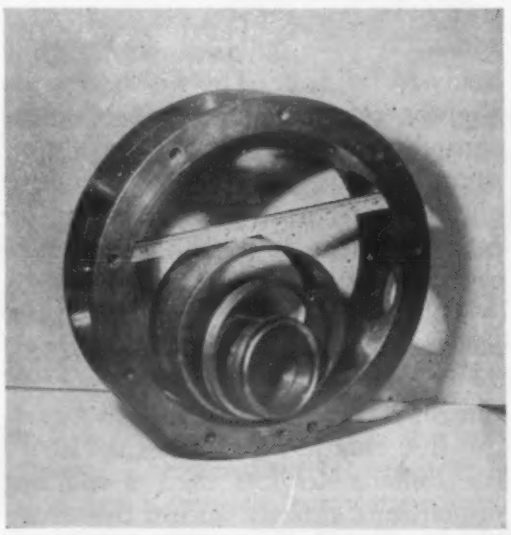
In addition to the cuprous alloys used for pressure die casting, there are several compositions that must be poured at higher temperatures, and these are used for gravity casting in permanent molds. These are an aluminum bronze, a manganese bronze, and a nickel-aluminum bronze, whose nominal compositions are also given in the accompanying table.

The aluminum bronze is poured at temperatures near 2100 F. It finds application where higher physical properties are needed than could be obtained from the pressure die cast metals, where shock loads will be applied, or where corrosion will be severe. Manganese bronze is poured at about 1925 to 2000 F, and the nickel-aluminum bronze is poured at temperatures of the order of 2200 F.

The difficulty of holding molten metals in metallic dies at these temperatures is shown in the range of die materials used. For the gravity die casting of yellow brass, the general purpose material, dies can be made of high test cast iron of the type known as Meehanite. For the metals poured at higher temperatures, tungsten die steels carrying about 13% of that alloying element are used, or alloy die steels of the nickel-chromium and tungsten heat resisting types. Even with special die materials, die life at the higher pouring temperatures is very short.

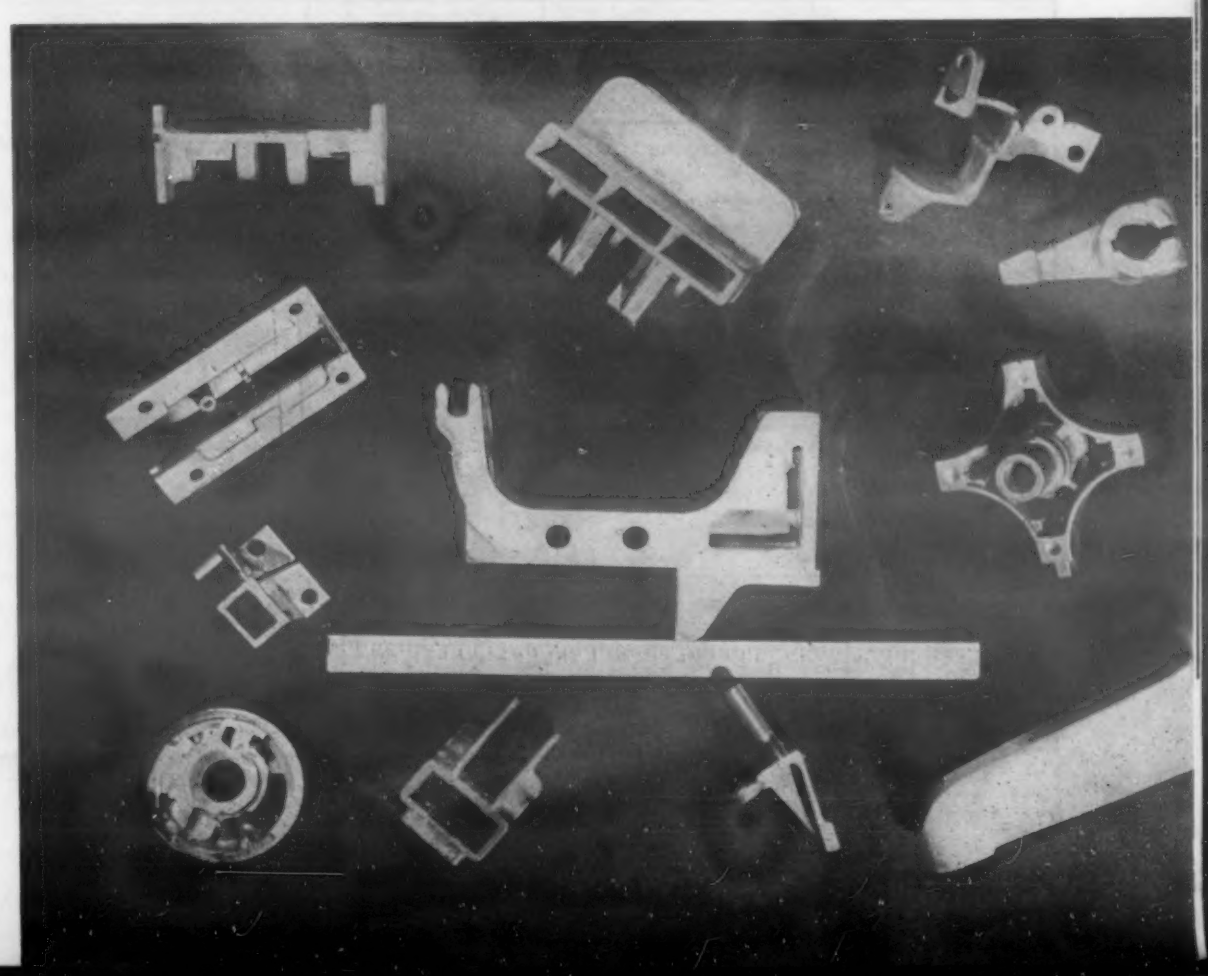
The weight of the piece is an important factor in die life. A heavy casting may permit the making of only about 10,000 pieces before the die must be discarded, whereas a light casting may have a run of 25,000 pieces per die. The shape of the piece is important also. A rather solid piece will hold heat longer and will cause shortened die life.

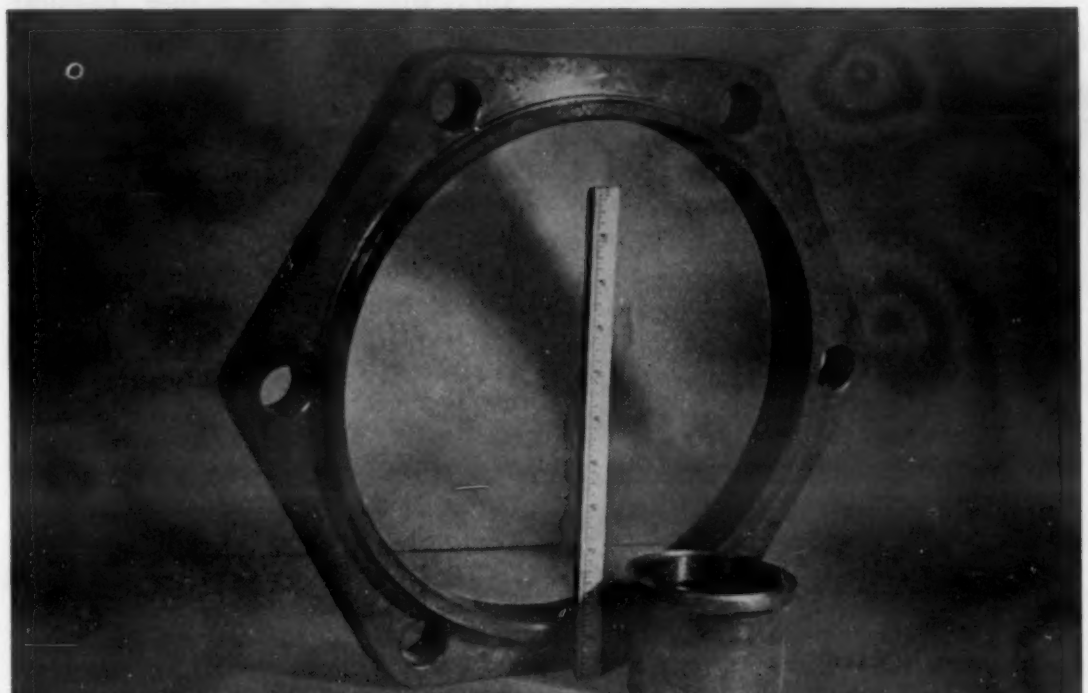
The surface of the die cavity is protected by a spray of Aquadag during pouring. The graphitic suspension helps to prevent sticking in the dies, and also lengthens die life



Above: Machined centrifugally cast aluminum bronze bearings and ball retainers.

Below: A group of permanent mold copper-base castings showing intricate shapes that can be produced in final form.





A centrifugal casting of aluminum bronze and a machined centrifugally cast bearing (foreground).

by providing a layer between the poured metal and the walls of the die.

Physical properties in the die-cast part are quite uniform throughout a run. Typical properties of the copper-base die casting alloys are given in the accompanying table. Physical properties of cuprous alloys cast in permanent molds by either gravity or pressure casting are generally higher than those of the same alloys cast in sand because of the chilling effect of the metal molds. Grain structure tends to be finer. The finish may be slightly rougher than that of pressure die castings of zinc or aluminum, but it is still smooth enough to eliminate the need for machining on many surfaces, or to reduce the necessary allowance for machining.

Tolerances must be somewhat larger than for aluminum and zinc die castings also; the tolerance on dimensions taken through the parting line should be about ±0.010 in. for dimensions less than 3 in., but dimensions entirely within the cavity in one die can be held to half that amount. Closer tolerances can be held at the cost of increased die maintenance. For larger dimensions, found in gravity die castings, tolerance for dimensions of from 3 to 6 in. should be ±0.015 in., and for dimensions larger than 6 in., ±0.020 in. should be allowed. Mold draft should be 0.015 in. per in. along the sides of the casting, and 0.020 in. per in. along the sides of cores.

In general, pressure die castings weigh from a few ounces to about 5½ lb. Gravity die castings may weigh as much as 15 lb. The pressure castings may have wall sections as thin as 3/32 in. in yellow brass, and down to 1/16 in. in silicon bronze. In gravity castings the minimum wall thickness should not be less than ⅛ in. The thickest wall sections that can be cast by pressure die casting, depending upon design, would be about ¼ in. if porosity must be held to a minimum, but if somewhat more porosity is permissible, the wall section may be increased to as much as ½ in. Die life will be substantially shortened if the heavier section is cast, due to the greater amount of heat to be absorbed by the die at that point.

Gravity die castings use steel core pieces where they can be managed, but where the design requires undercuts that could not be obtained with steel cores, sand cores can be used.

Due to the higher temperatures of the metal cast, dies for cuprous alloys tend to develop surface imperfections more quickly than those for aluminum or zinc. New dies produce castings with a finish comparable to that of aluminum, but after continued use the dies tend to develop hairline cracks which are reproduced on the surface of the cast piece as slight raised imperfections. They are removed without difficulty if the piece is to be plated.

Parts made of cuprous alloys by die casting, gravity or pressure include plumbing fixtures, small parts for printing presses, electrical switch parts with unsymmetrical shapes, brush holders, gears with cast teeth, special couplings, and ball and roller bearing retainers. Venturi tubes have been made with bores cast to size. Small pieces with special shapes can be cast to close dimensions, then coined to size. Pump impellers are cast with a smooth finish and dimensional accuracy in the blades. Gears have been cast with steel shafts as inserts, and the teeth either cast to size or finished by a trimming operation.

Composition and Strength Properties of Copper-Base Die Casting Alloys

	Alloy	Nominal Composition, %	Ten. Str., Psi	Yld. Str., Psi	Elong., % in 2 In.
Pressure Die Casting	General purpose brass	Zinc, 40 Copper, 60	50,000-60,000	35,000	12
	Silicon bronze	Silicon, 1 Zinc, 16 Copper, 83	75,000-85,000	40,000	6-8
Gravity Die Casting	Aluminum bronze	Aluminum, 10 Copper, 89 Iron, 1	80,000	36,000	17-26
	Manganese bronze	Manganese, 1 Aluminum, 2 (max) Iron, 2 (max) Zinc, 37 Copper, 58	75,000	30,000	20
	Nickel-aluminum bronze	Aluminum, 10 Nickel, 3 to 6 Manganese, 3.5 (max) Iron, 3 to 6 Copper, balance	80,000	30,000	12

How to Join Nickel and High-Nickel Alloys by Resistance Welding

by ROBERT M. WILSON, JR.,
The International Nickel Co.

All the conventional resistance processes can be used to join nickel and nickel alloys to themselves and to many other ferrous and nonferrous metals.

● NICKEL AND THE high-nickel alloys can be joined relatively easily to themselves and to many other ferrous and nonferrous metals and alloys by the resistance welding processes with equipment in common use throughout industry.

As with other metals, resistance welding is particularly suitable for mass production joining of nickel and nickel alloys. Welds are machine-made at high speeds by operators who can be trained quickly. Thus, the labor cost per piece is low. On the other hand, resistance welding machines are expensive. To justify the use of resistance welding, a large volume of identical or similar parts is required in order to obtain low labor and machine cost per piece.

In the resistance welding of nickel and the high-nickel alloys, the following processes are used:

1. Spot welding
2. Projection welding
3. Seam welding
4. Flash welding
5. Resistance brazing

Spot, projection and seam welding are modifications of the same process. In all of these methods, lap joints are made by local fusion of a small area, and the processes are limited to applications involving relatively thin sheet or strip. They have certain disadvantages. The lap-joint has a crevice between sheets which acts as a stress-raiser where fatigue is a factor. This type of joint is a source of trouble under corrosive conditions also. Flash welding is a joining process applied to rod, bar, pipe and sheet to produce a butt joint. There is no inherent crevice in this type of joint, and flash welds are superior to spot, projection and seam welds for applications under fatigue or corrosive conditions. Resistance brazing is a normal brazing process accomplished on a spot or seam welder.

Spot Welding

The principal factors involved in spot welding are pressure, time and current. The function of pressure is to provide intimate contact between electrodes and the sheets to be joined; to contain the molten nugget during current flow under the high pressure built up by the welding heat; and to provide a forging action during nugget solidification to overcome shrinkage. The time of current flow should be kept as short as possible with a given sheet thickness to prevent overheating, distortion and mushrooming of the electrodes. Accurate timing equipment is advisable and is essential if short welding intervals are used. Current is the last variable to be fixed, and is selected to lie in the range between that at which a nugget is just formed and that at which expulsion of the nugget occurs.

In spot welding, nickel has properties similar to those of mild steel and the same procedures can be followed. The high-nickel alloys are generally harder and stronger than low-carbon steel, and greater pressures are required. Machines for spot-welding the high-nickel alloys must have adequate pressure capacity. The electrical resistances of nickel and mild steel are similar while the resistances of the high-nickel alloys are generally much higher. Current requirements for nickel and the high-nickel alloys are similar to or slightly less than those required for mild steel but are a great deal less than those required for aluminum.

Suitable electrode materials for spot-welding the nickel alloys are shown in Table 1. Normally both electrodes are of the same composition and, therefore, have the same conductivity. However, it may be necessary to employ electrodes with different conductivities in welding sheet of unequal thickness or in welding dissimilar metals. An example is the use of molybdenum-faced electrodes in spot welding unequal thicknesses of Inconel sheet.

The full-domed electrodes used in the spot-welding of aluminum are

Table 1—Recommended Electrode Material for Spot-Welding High-Nickel Alloys

Material	RWMA* Classification	Rockwell Hardness	Conductivity I. A. C. S. %
Copper Alloy	Grade A Class 1	68 Rb	80
Copper Alloy	Grade A Class 2	75 Rb	70
Molybdenum Alloy	.....	83 Rb	33

** Resistance Welder Manufacturer's Association*

Table 2—Recommended Conditions for Spot-Welding Annealed Nickel, Monel and Inconel Sheet

Thickness, In.	Electrode Dia, In.	Electrode Force, Lb	Weld Time, Cycles	Weld Current, Amp	Min. Contact Overlap, In.	Min. Weld Spacing, In.	Dia Fused Zone, In.	Avg. Shear Str., Lb	Min. Shear Str., Lb
Nickel									
0.005	5/32	100	3	7,100	1/4	3/8	0.10	40	30
0.010	3/16	130	3	11,800	1/4	3/8	0.12	170	135
0.015	3/16	250	3	12,300	1/4	7/16	0.12	225	180
0.021	5/32	370	4	7,800	5/16	9/16	0.12	440	350
0.031	3/16	900	4	15,400	3/8	7/8	0.18	950	760
0.063	1/4	1720	6	21,600	5/8	1 1/2	0.25	3000	2400
0.094	5/16	2300	12	26,400	3/4	1 7/8	0.31	4500	3600
0.125	3/8	3300	20	31,000	7/8	2 1/4	0.37	7000	5600
Monel									
0.005	5/32	220	2	5,000	1/4	1/4	0.10	70	55
0.010	5/32	270	2	7,200	1/4	1/4	0.12	180	145
0.015	3/16	300	2	8,600	1/4	5/16	0.13	310	250
0.021	3/16	300	12	6,200	5/16	7/16	0.13	560	450
0.031	3/16	700	12	10,500	3/8	5/8	0.17	1056	845
0.063	5/16	2700	12	15,300	5/8	1 1/8	0.31	2584	2060
0.093	3/8	2760	20	22,600	3/4	1 1/4	0.37	4860	3880
0.125	1/2	5000	30	30,000	7/8	1 5/8	0.47	7300	5850
Inconel									
0.005	5/32	300	2	7,000	1/4	1/4	0.11	90	70
0.010	3/16	320	4	7,500	1/4	1/4	0.12	220	175
0.015	3/16	360	6	7,600	1/4	1/4	0.12	370	295
0.021	5/32	300	12	4,000	5/16	7/16	0.12	680	545
0.031	3/16	700	12	6,700	3/8	9/16	0.18	1150	920
0.063	5/16	2070	12	12,000	5/8	1 1/8	0.31	3450	2750
0.093	3/8	3870	20	15,000	3/4	1 3/16	0.37	5500	4400
0.125	7/16	5270	30	20,100	7/8	1 5/16	0.44	8000	6400

Electrode material:	*Class 1*	*or*	*Class 2*	*or*	*Molybdenum Freed*
Minimum conductivity	*80% Cu*		*75% Cu*		*33% Cu*
Minimum hardness	*Rb 68*		*Rb 75*		*Rb 83*

not satisfactory for welding the high-nickel alloys. Hard alloys resist the indentation of a full dome and proper forging is not possible; thus, porosity and cracking may occur. A cone-shaped electrode is preferred, with the cone having an angle of 10 deg for nickel and 20 to 30 deg for the alloys.

Machine settings which have proved satisfactory for welding nickel, monel and Inconel are shown in Table 2. Such data are not available for the age-hardenable alloys, Duranickel, "K" monel and Inconel "X". These alloys can be welded with similar settings to those used for monel and Inconel with the provision that more pressure and slightly less current be used to compensate for the greater strength and higher resistance of the alloys. Some cracking may occur when spot-welding the age-hardenable alloys if the pressures are too low.

Nickel and the high-nickel alloys can be spot-welded to themselves and to other materials, such as mild steels, low-alloy steels, stainless steels, some of the copper alloys, tungsten

Table 3—Recommended Conditions for Spot Welding Some Dissimilar Metals Combinations

Material Combination	Thickness, In.	Electrode[3] Size, In.	Electrode Force, Lb	Weld Time, Cycles	Weld Current, Amp	Min. Overlap, In.	Min. Weld Spacing, In.	Dia Fused Zone, In.	Shear Str., Lb
Nickel—Mild Steel	0.063	5/16	1500	10	16,200	5/8	1 1/4	0.25	2200
Nickel—Low Alloy Steel (8630)	0.063	5/16	1500	10	14,500	5/8	1 1/8	0.25	2350
Nickel—Stainless Steel[1]	0.063	5/16	1800	12	16,000	5/8	1 1/8	0.25	2700
Nickel—Monel	0.063	5/16	2000	12	20,000	5/8	1 1/4	0.28	2900
Nickel—Inconel	0.063	5/16[2]	2500	12	15,500	5/8	1 1/8	0.26	2750
Monel—Mild Steel	0.063	5/16	1600	14	17,500	5/8	1 1/4	0.25	2300
Monel—Low Alloy Steel (8630)	0.063	5/16	1600	14	16,800	5/8	1 1/8	0.25	2450
Monel—Stainless Steel[1]	0.063	5/16	1800	14	16,000	5/8	1 1/8	0.25	2800
Monel—Inconel	0.063	5/16	2300	14	15,500	5/8	1 1/8	0.25	3000
Inconel—Mild Steel	0.063	5/16	1600	14	17,000	5/8	1 1/4	0.23	2200
Inconel—Low Alloy Steel (8630)	0.063	5/16	1600	14	16,000	5/8	1 1/8	0.25	2300
Inconel—Stainless Steel[1]	0.063	5/16	2500	16	14,000	5/8	1 1/8	0.28	2950
Stainless[1]—Mild Steel	0.063	5/16	1600	14	18,000	5/8	1 1/4	0.25	2170
Stainless[1]—Low Alloy Steel (8630)	0.063	5/16	1600	14	17,500	5/8	1 1/8	0.26	2400

[1] *18-8 Stainless.*
[2] *Class III electrode against nickel sheet.*
[3] *Electrodes RWMA Class II 3-In. Radius of Dome.*

and molybdenum. However, they cannot be spot-welded to aluminum and magnesium alloys. Suggested conditions for welding a number of dissimilar metal combinations are indicated in Table 3, which gives also the strengths which can be expected from welds made under the specified conditions.

Projection Welding

Projection welding is merely a special form of spot welding used particularly for the welding of small parts or the joining of small to large components. Much of the discussion on spot welding applies equally to projection welding. The process has the advantages that projections can be put on small areas on which spot welding is impossible, more than one weld can be made with a single stroke of the machine, electrode life is lengthened, and the joining of difficult dissimilar metal combinations is possible. It has the disadvantages that a preliminary operation is necessary to form the projection, all projections should be seated at one blow, and special welding dies are required.

In preparing sheet material for projection welding, it is necessary that the height of the projection be governed by the thickness of the piece to which the part bearing the projection is to be joined. This height will be about 80% of the thickness for thin materials and about 50% for thicker materials. If possible, the projection should be placed on the thicker piece or on that having the higher conductivity.

Since the shape of projections, size of parts to be joined, and location of the projection are highly specialized, no general information can be furnished for machine settings which would be useful. Settings are obtained by trial for each job. For small parts, flat electrodes can be used in conventional spot welding machines.

A special form of projection welding is cross-wire welding in which the wires serve as the projections. This process is used in the fabrication of screens of nickel or high-nickel alloys and in the manufacture of pickling equipment. Flat electrodes are generally used. Recommended conditions for cross-wire welding are given in Table 4.

Table 4—Recommended Conditions for Cross Wire Welding

Wire Dia, In.	Electrode Pressure, Lb	Firing Time, Cycles	Current, Amp
Nickel			
1/16–1/16	90	2	2000
1/8–1/8	180	3	4500
3/16–3/16	360	6	7000
1/16–1/8	90	2	2200
1/16–3/16	90	2	2400
1/8–3/16	180	6	5000
Monel			
1/16–1/16	100	2	1630
1/8–1/8	200	3	3700
3/16–3/16	400	6	5700
1/16–1/8	100	2	1790
1/16–3/16	100	2	1950
1/8–3/16	200	3	4050
Inconel			
1/16–1/16	125	2	1050
1/8–1/8	250	3	2300
3/16–3/16	500	6	3600
1/16–1/8	125	2	1100
1/16–3/16	125	2	1200
1/8–3/16	250	3	2500

Seam Welding

Seam welding is a special form of spot welding in which the electrodes are disks. Current is turned on and off in a regular pattern as these disks roll over the work, with the result that a series of spot welds is formed. If a gas tight weld is required, the disk speed and time cycle are adjusted to obtain a series of overlapping spot welds. Much of the discussion on spot welding applies to seam welding also, since both are merely variations of the same process.

The high-nickel alloys have been seam welded in thicknesses from 0.002 to 0.125 in. Ordinarily an overlap greater than that used for spot welding is employed since most seam welding is guided by hand. The current requirements for seam welding Inconel are similar to those for stainless steel, while nickel and monel will require greater current because these alloys have lower resistance. The pressures required for these alloys are high in order to forge the solidifying nugget and prevent cracking and porosity. The upper limit of pressure is indicated by mushrooming of the disk or by distortion of the work. Recommended conditions for seam welding monel are shown in Table 5.

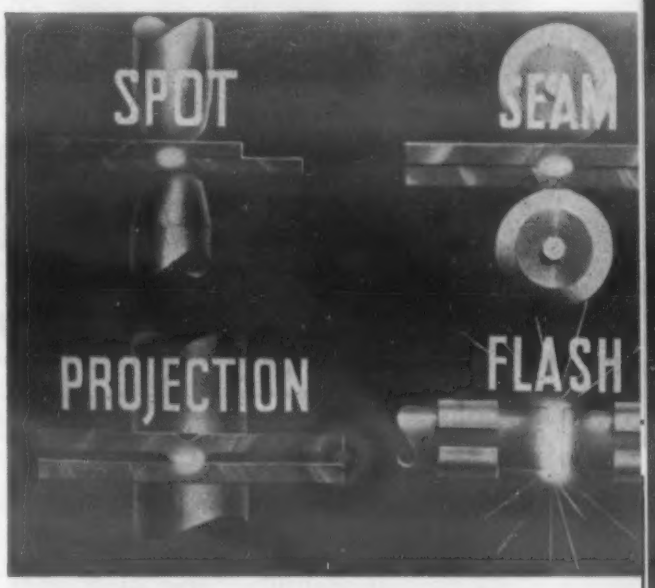
The strength of a properly made seam weld is always higher than the base material, and mechanical tests are seldom applied to these welds. However, freedom from leakage is frequently desired and seam welds are usually pressure tested for this property.

Nickel and the high-nickel alloys can be seam welded to mild steels, low alloy steels, stainless steels, and some of the copper alloys. They cannot be seam-welded to aluminum or magnesium alloys.

Flash Welding

Flash welding is a process which produces a butt joint instead of the lap joints obtained in the other resistance welding processes. A properly made joint contains no dendritic material (metal which has been melted). These two features of the flash welding process are very useful in producing equipment for service under corrosive conditions. The butt weld has no incipient crack in which corrosion can start, while absence of dendritic material minimizes preferential attack, which occurs frequently when fusion welds are employed.

Flash welding can be made automatic, and the operators of the equipment require little skill. The operation is rapid, thus the labor cost per piece is low. However, the equipment is expensive and a large volume of similar joints is required to justify the expense of installing the process.



The four principal types of resistance welding are applicable to nickel and high nickel alloys. (General Electric Co.)

In making a flash weld, metal is lost during flashing and the resulting decrease in length of the piece must be taken into account in designing parts to be produced by this method. The total loss in length varies from one to six times the thickness of the parts being welded, the greater loss occurring in the welding of thin pieces. Flash from the operation must be removed in many cases, particularly for service under corrosive conditions. Flash welding is very valuable for joining dissimilar metals.

The voltage and current require-

Table 5—Recommended Conditions for Seam Welding Monel

SET-UP VARIABLES			WELDING VARIABLES					FUSION ANALYSIS			
Thickness in In. and Gage	Electrode Shape, In.	Electrode Force Lb	Timing Cycle, Cycles "On" Time	Timing Cycle, Cycles "Off" Time	Weld Spacing, Welds Per In.	Wheel Speed, In. Per Min.	Welding Current, Amp	Width of Fused Zone, In.	Weld Overlap, %	Weld Penetration, %	
0.062—16	d = 3/8 R = 6	2500	8	12	9	20	19,000	0.17	10	35	Optimum
		2400-2600	6-10	8-15	7-11	—	16,000-21,000	0.0-0.25	0-15	0-40	Permissible range
0.031—22	d = 3/16 R = 6	700	4	12	12	19	10,000	0.15	20	40	Optimum
		600-800	3-6	8-15	10-14	—	8,500-11,000	0.0-0.18	0-25	0-45	Permissible range
Electrodes Unburnished 0.021—25	d = 3/16 R = 6	600	3	12	11	22	9,500	0.15	10	35	Optimum
		500-700	2-4	8-15	10-12	—	8,000 10,000	0.0-0.18	0-15	0-40	Permissible range
Electrodes Burnished 0.021—25	d 3/16 R = 6	500	2	6	12	38	8,700	0.15	20	40	Optimum
		400-600	1-3	4-8	10-14	—	7,200-8,900	0.0-0.18	0-25	0-50	Permissible range
Electrodes Burnished 0.015—29	d = 5/32 R = 6	300	1	3	12	75	7,600	0.10	15	35	Optimum
		250-350	½-1½	2-4	11-13	—	6,800-7,800	0.0-0.11	0-20	0-40	Permissible range
Electrodes Burnished 0.010—32	d = 5/32 R = 3	200	1	3	12	75	5,300	0.09	15	30	Optimum
		150-250	½-1½	2-4	11-13	—	4,800-5,300	0.0-0.10	0-20	0-35	Permissible range

ments at the start of the operation are high in order to initiate flashing. As flashing continues, this high level of energy input is not needed. A further reduction in energy is desirable during upsetting. On older types of machines in which the energy level is controlled by taps on a transformer, no change can be made during the flashing period and a compromise setting must be used. On more modern machines, with ignition control, a change in energy level can be made at any time. These machines produce more consistent welds.

If the energy level is too low at the beginning of flashing, "freezing" may occur, the arc is extinguished, and, as a result, a large volume of metal is heated by resistance. This metal usually melts and drops out of the joint and no weld is obtained. If the energy level is too high during flashing, the particle size of the flash will be coarse and oxidation of the larger pits formed during flashing may occur. Such oxidized areas may not be extruded during upsetting, the resulting weld will contain oxide in-

Table 6—Recommended Conditions for Flash Welding Nickel Alloy Rods

Material	Rod Dia, In.	End Preparation*	Flashing Distance, In.	Flashing Time, Sec	Current Duration During Upset, Cycles	Upset Distance, In.	Watt Hr/Weld	Weld Str., Psi	Rod Str., Psi
Nickel	1/4	Pointed	0.442	2.5	1½	0.125	2.15	58,000	65,100
Nickel	3/8	Pointed	0.442	2.5	2½	0.145	4.87	65,600	66,500
Monel	1/4	Pointed	0.442	2.5	1½	0.125	1.93	68,500	70,500
Monel	3/8	Pointed	0.442	2.5	2½	0.145	5.55	80,300	84,700
"K" Monel	1/4	Pointed	0.442	2.5	1½	0.125	2.02	93,900	100,000
"K" Monel	3/8	Pointed	0.442	2.5	2½	0.145	4.79	98,800	99,000
Inconel	1/4	Pointed	0.442	2.5	1½	0.125	2.15	101,200	109,800
Inconel	3/8	Pointed	0.442	2.5	2½	0.145	5.19	102,000	106,000

** 110-deg. included angle*

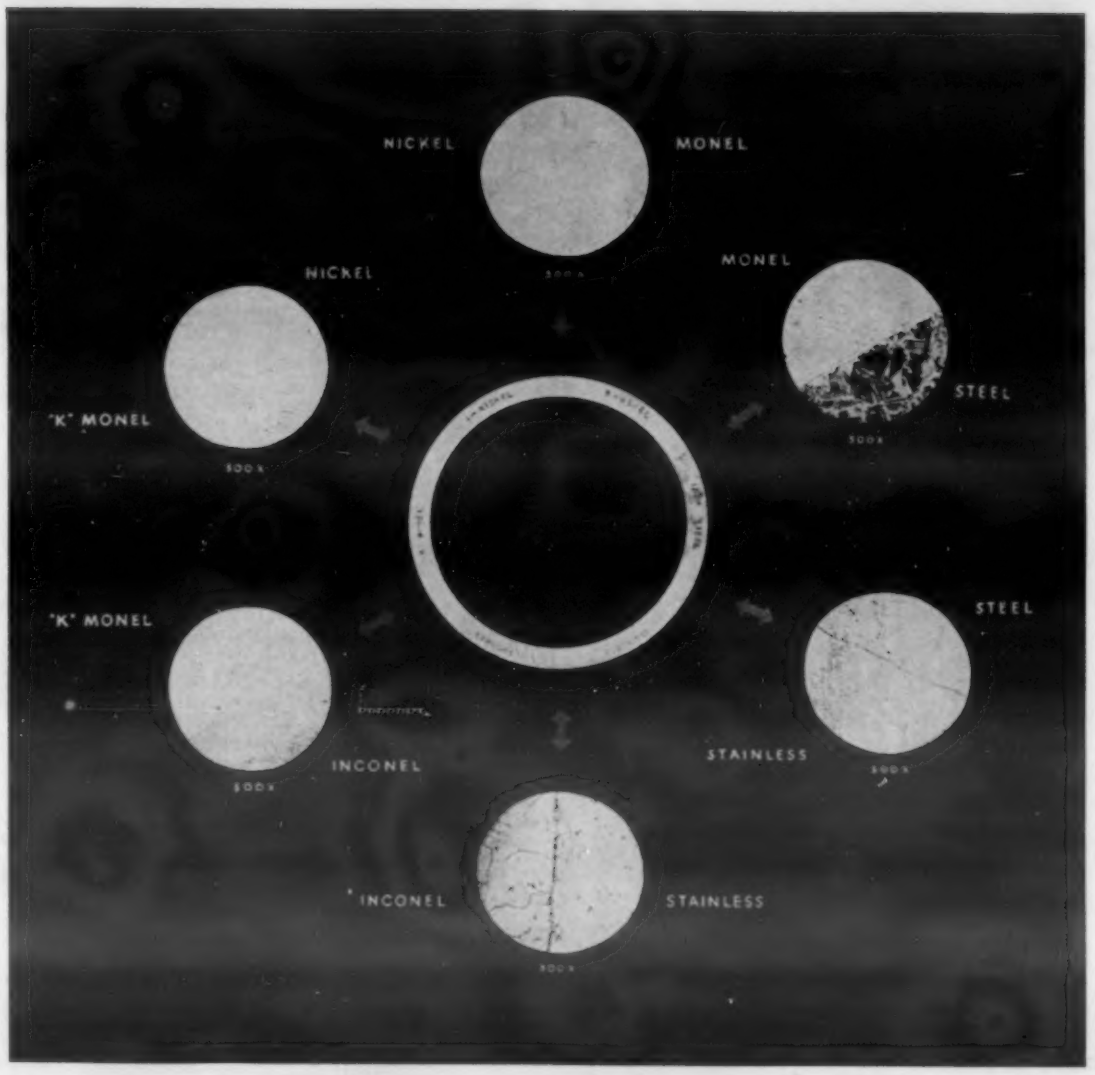
clusions or voids, and the strength will be low. If the energy level is too high during upset, the timing of current cut-off after upsetting is critical. If the time interval is too long, the material will be spoiled by overheating. If too short, the material will not be plastic enough to forge properly. On older machines, the time of cut-off after upset is of the order of 2 to 4 cycles.

The pressure requirements for welding nickel and the high-nickel alloys are generally higher than those required for mild steels, averaging 35,000 psi. The function of pressure is to forge the weld and extrude the oxidized and molten material from the joint. If insufficient pressure is employed, the welds may contain voids, oxidized metal, or some cast structure. If too much pressure is employed, the machine attempts to make a weld where the material is not sufficiently plastic and a poor weld results.

Procedures for flash welding nickel, monel, "K" monel, and Inconel bars are given in Table 6. These data were obtained on old type machines where the current could not be adjusted during the welding cycle. A joint efficiency of 95% is generally achieved in flash welding. The strength of the welds approaches that of the annealed material since it is not possible to flash weld without annealing a portion of the material adjacent to the weld. In age-hardenable materials, such as "K" monel, Duranickel and Inconel "X", the weld will respond to heat treatment in the same manner as the annealed base material.

It is possible to flash weld many dissimilar metal combinations which would be impossible to join by other welding procedures. However, specific machine settings cannot be given for such joints. An accompanying figure shows a flash welded ring composed of monel, nickel, "K" monel, Inconel, Type 347 stainless steel and SAE 1020 steel. The photomicrographs illustrate the sharp demarkation lines at the weld interfaces.

Flash welding is used to produce pickling chains from monel bar stock up to 1 in. in dia, the side seams of monel hot-water tanks, and Inconel rings for jet engines.



Nickel and nickel alloys are readily resistance welded to each other and to certain steels, as indicated by the flash welded dissimilar metal ring and the photomicrographs showing the weld interfaces.

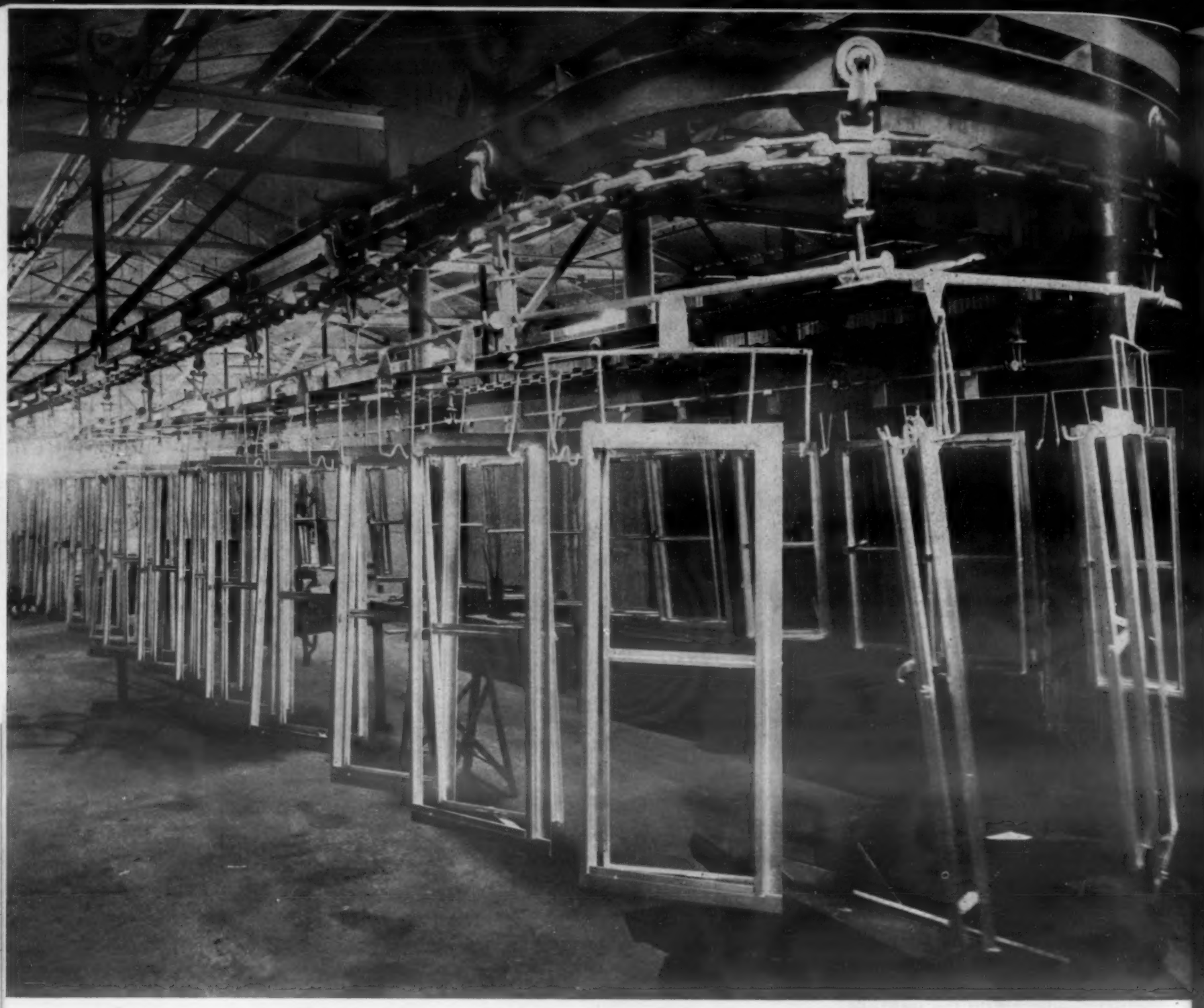
Resistance Brazing

Spot welding machines can be used for silver brazing small assemblies. Heating for resistance brazing is accomplished by passing a large current through high resistance electrodes which are in contact with the parts to be brazed. Although the current passes through these parts, most of the heat required for the operation is generated in the electrodes and reaches the joint by conduction. The current used is much lower than that required for spot welding and the time is much longer. Carbon, tungsten or molybdenum electrodes are used.

Any silver brazing alloy not containing phosphorus is satisfactory for resistance brazing. A fluid flux should be used and should not be permitted to dry before brazing, for dry flux in the joint may interfere with the passage of the current. Parts should be annealed before brazing.

The current used for brazing is selected to obtain uniform heating at a suitable rate. Relatively long heating is required, of the order of 1 sec to 2 min, although the operator usually judges the time by watching the work. When the brazing alloy has melted, the current is turned off but electrode contact is maintained until the alloy has solidified.

Spot welding on Inconel aircraft component. (Taylor Winfield Corp.)



The smooth, crystalline phosphate coatings on metal make excellent paint bases. The paint is anchored to the surface and the metal has the additional protection of the phosphate coating if the paint chips in use.

The Basic Types of Phosphate Coatings and Where to Use Them

by **ROBERT F. AYRES, Oakite Products, Inc.**

For maximum economy and performance, a phosphate conversion coating must be selected that fits the specific requirements of the product.

● PHOSPHATE COATINGS are applied to iron, steel, zinc, cadmium and aluminum by spraying, dipping or painting the surface of the metal with solutions of acid phosphates so that a protective layer of phosphate crystals is formed on the surface. The solutions used, the exact composition of the coating, its thickness, and the methods of treatment differ widely according to the applications for which the coated metal is intended and the patented process used.

In the past, trade names rather than generic designations have predominated in regard to phosphate coatings. The wide application of phosphate coatings and the developments still going on have resulted in a whole forest of proprietary finishes, and any generic classification must be approximate.

However, an understanding of the basic types of coatings that are available is of definite value to the engineer in choosing the finish required for specific products. The most important point is that phosphate coatings are not limited to any one application. For maximum economy and performance, the type chosen must fit the product.

Phosphate conversion coatings, as the name implies, are integral with the surface of the base metal. The protective crystals consist mainly of phosphates of iron, zinc, zinc-iron, manganese-iron or of aluminum and chromic phosphates; these crystals are chemically and physically a part of the metal surface. The exact composition of the coating depends upon the type of bath used and the method of treatment, the most general rule being that the phosphate of the base metal is always included as a major or minor constituent.

The cleaning of metals by solutions based on phosphoric acid should be clearly differentiated from true phosphate coating treatments. The cleaning solutions consist essentially of phosphoric acid, organic grease solvents and surface active agents. The purpose is to remove rust and grease from the metal in one treatment, leaving a slight surface etch to promote mechanical bonding with paint, plus a thin phosphate residue which gives some resistance to corrosion. The phosphoric acid concentrations used and the quality of the detergent constituents usually insure the removal of oxides, dirt and grease, but the acidity of these cleaning solutions is necessarily too great to permit the build-up of any substantial crystalline phosphate coating on the metal. The big difference between phosphoric acid cleaning and acid phosphate coating lies in the low pH maintained in the cleaning solutions. Phosphoric acid cleaning has a valuable place in industry, however, particularly for manual application to parts too bulky for washing machine or tank immersion treatments.

The important functions of phosphate coatings are:

1. The insulating properties tend to suppress electrochemical corrosion under a paint film, restricting attack to the site of any damage.
2. The physical form of the phosphate layer serves to key an organic finish to the surface.
3. An actual chemical bond is formed between the paint and the surface.
4. The absorptive characteristics of phosphate coatings and their affinity for oils and lubricants lead to corrosion resistance and reduced wear.

Types

There are five main generic types of commercial phosphate coatings. These consist of the phosphates of manganese and iron, (2) zinc and iron, (3) zinc, (4) aluminum and chromium, and (5) iron. The characteristics of each of these types, such as thickness, crystalline structure and chemical composition, depend on the method of cleaning before treatment, the system for applying the phosphating solution, the duration of the treatment, and the composition of the bath. Choice of the type of material to be used and the method of application depends upon the metal to be treated and the purpose the coating is to serve.

Manganese-Iron Phosphates—These are heavy coatings ranging from 1000 to 4000 mg per sq ft in weight. They are used principally to improve lubrication properties on friction surfaces of iron and steel. Application is by immersion methods and requires a time of treatment from 10 to 30 min. The lubricating assistance which these coatings give is due both to the fact that they form parting layers and to their high absorptive affinity for lubricants. Pistons, piston rings, cylinder liners, connecting rods, crankshafts, gears, valves, bearings, etc., carry uniform oil films over their entire surfaces because of the presence of the phosphate coating, and the dangers of metal-to-metal contact are greatly reduced or eliminated. The coatings also decrease running-in time, for the same reasons. The same coatings are also used frequently as carriers of oil to retard corrosion on surfaces where friction is no problem.

Zinc-Iron Phosphates—There are several different kinds of zinc-iron phosphate coatings. Each type is designed to form a surface for oiling to prevent corrosion, to function as an aid in cold working, or to provide a paint base.

Coatings ranging in weight from 1000 to 4000 mg per sq ft are applied to iron and steel, and subsequently oiled to prevent rust. Nuts, bolts and screws are typical of the kind of work processed, but larger parts are frequently treated in the same manner. These coatings are commonly applied by 20- to 30-min immersion, but spray application is occasionally used.

Coating weights in the range between 150 and 3000 mg per sq ft are employed to improve the cold working of metals. The coating acts as a lubricant carrier and a parting layer to facilitate the drawing of wire, rod and tubes, and the cold pressing and extrusion of steel. The coating also increases die life and reduces power requirements. Immersion methods of application which require 3 to 5 min are used.

A third variety of zinc-iron phosphate coating weighs between 100 and 600 mg per sq ft and is widely used as a surface treatment for iron and steel before painting. The same principles apply as for the heavier, wear-resistant and oil carrying types, but the crystals are smaller and are usually developed in a much shorter time by means of accelerators incorporated in the bath. Application can be by brush, dip or spray methods. By certain modifications in the solutions, the same material sometimes can be applied to zinc, cadmium and aluminum, and frequently several of these metals are processed through the same machine. For example, a finished product may consist of steel, cast iron, and aluminum or zinc die-cast parts, all of which are coated with the same solution before assembly and painting.

Zinc Phosphate—This type of coating is produced on zinc and cadmium surfaces as a base for paint. The coating weight runs from 75 to 200 mg per sq ft, and the surface has a medium to dark gray appearance. Galvanized steel, zinc-base die castings, electrodeposited zinc or cadmium parts are examples of work that may benefit by this treatment. Immersion or spray application accomplishes the purpose in 2 min or less.

Aluminum-Chromic Phosphates—In addition to the treatment of aluminum with modified solutions of the zinc-iron type to form a gray crystalline layer on the surface, there are processes which produce amorphous coatings composed of aluminum and chromic phosphates. Coating weights run from 20 to 200 mg per sq ft, and application can be by brush, immersion or spray, with treatment times ranging from 20 sec to 5 min. These coatings are usually preparations for painting but they are sometimes used unpainted to increase corrosion resistance. This type of treatment is also occasionally used to produce thin protective coatings of iron-chromic or zinc-chromic phosphates on those respective metals.

Iron Phosphates—Thin, hard,

highly continuous phosphate coatings for metals have come into increasing use in the last decade. In addition to their paint bonding and corrosion inhibiting properties, the economy and ease of their use enhances their value to industry. Fewer steps are required because one solution usually performs both the cleaning and coating operation, maintenance and control of the bath is relatively simple, acid proof equipment is not required, and the problem of heavy sludge accumulation is absent.

These coatings, while composed primarily of iron phosphates when formed on iron and steel, must include also a certain proportion of other insoluble heavy metal oxides or phosphates if the coatings are to achieve their maximum protective value. Provision for such supplementary deposits can be incorporated in the formulas, along with proper oxidizing agents and/or activators.

In contrast to the palpable crystal structure and gray-to-black appearance of other phosphate treatments, these thin, hard coatings may develop an iridescent surface due to the extreme thinness of the layer, which can approach the wave length of visible light in magnitude.

On nonferrous metals, this type of bath usually requires certain modifications to produce visible films, but even with no obvious surface change, experience has shown that the treatment leads to improved results in paint adhesion and corrosion resistance.

The best method of application is by pressure spray washer, although tank immersion is frequently employed. Treatment time runs from 1 to 5 min.

These steel door frames require no precleaning before entering the three-stage washing machine where a thin, crystalline phosphate coating is applied. After drying, the frames are painted.

Coating Reactions

The manganese-iron, zinc-iron and zinc types of phosphating solutions contain the primary phosphates of those respective metals dissolved in a moderate excess of phosphoric acid. It is necessary that this excess of acid, called "free acid," be present in order to prevent hydrolysis of the primary metal phosphates, with their consequent precipitation as the secondary and tertiary salts. Also important to these baths is the amount of "total acid". This term means the acid which combines with the metal in solution to form the primary phosphate, plus the free acid. In order to achieve phosphating action in the bath, it is essential that the ratio of free to total acid be maintained within certain narrow limits. This arises because of the following mechanisms:

When metal parts to be treated are immersed in, or are sprayed by, the phosphating solution, the surface is attacked by the acid and the amount of free acid in the solution close to the surface consequently is reduced to the extent that the solubility of the metal phosphates decreases locally, and interlocked crystals are deposited. The base metal is dissolved to some extent and its phosphate is included in the crystalline layer. If the acid concentration is excessive in relation to the metal phosphate concentration (high free acidity), the phosphates do not reach the insoluble state at the reacting surface and the metal is merely etched, without crystal formation. With an acid concentration that is relatively too low (low free acidity), on the other hand, the reaction proceeds slowly or not at all, and much of the metal phosphate in the bath may sludge out.

The same mechanisms apply to the iron phosphate type of coating reactions, but by means of various regulating, accelerating or activating agents it has been found possible to produce thin, hard continuous coatings with the more mildly acid alkali metal phosphates.

The primary phosphate salts of iron, zinc and manganese are soluble in water; the secondary salts are very slightly soluble; while the tertiary phosphates of these metals are highly insoluble. The soluble primary salts make up the working solution and the durable tertiary salts form the protective coating.

Slow and Fast Baths

The heavier, thicker phosphate coatings that are utilized in the waxed or oiled conditions for corrosion protection are ordinarily formed from "slow" baths, requiring 10 to 30, sometimes even 60, minutes of treatment, with temperatures in the range of 200 to 210 F. These baths are of the zinc-iron or the manganese-iron composition.

Lighter coatings for paint bonding, usually comprised of zinc, zinc-iron or iron phosphates, are produced with *"fast"* baths containing accelerators, in from 30 sec to 5 min. Temperatures may range from near room temperature to 210 F. About 145 F is average. There are modifications of this process which coat rapidly moving, continuous strip stock in a matter of 7 to 15 sec. Fast baths of the zinc-iron or manganese-iron types contain oxidizing agents, such as nitrates, nitrites or chlorates. The primary function of the oxidizing agent is to prevent the formation of an insulating film of hydrogen gas on the metal surface by converting the gas to water during the phosphating reaction. In the case of the iron phosphate type of coating, the oxidizing agent also insures the formation of the ferric rather than the less inert ferrous crystal.

The iron phosphate is a "fast" type of solution, requiring 1 to 3 min. in spray application, and 1 to 5 min. by tank immersion. Temperatures used are around 160 F.

The slow phosphating process almost always involves some form of immersion treatment, whereas the fast types can be applied either by spraying or immersion. Spraying is usually done with power washers, although there are some applications using hand spray guns. A few solutions are even designed for brush application.

Cleaning and Rinsing

The phosphating solution must have access to all parts of the metal surface to let the chemical reaction take place evenly and insure a good coating. With the heavy metal primary phosphate baths (zinc, manganese, iron), it is essential that the metal parts enter the solution free of millscale, grease, oils and dirt. Acid-pickling or shot-blasting are required for scaled or rusted stock, and precleaning cycles, using vapor degreasers, hot alkaline solutions or solvent emulsion cleaners, must precede the phosphating bath.

The complex, thin iron phosphate

Types and Applications of Phosphate Coatings*

Type of Coating	Products Treated	Weight of Coating and Application	Processes	Commercial Designations
Manganese-iron phosphate on iron and steel.	Friction surfaces on machine parts; chill-faced and nitrided bearing surfaces.	1000 to 4000 mg per sq ft. To increase wear resistance, cut break-in friction, and hold lubricant. Also oiled for corrosion prevention.	Surface is degreased or mechanically cleaned. Coating is applied by 10- to 30-min immersion.	Irco 66 "X", Metalcote 628, Parco-Lubrite, Parco Powder, Rustshield.
Zinc-iron phosphate on iron and steel.	Fabricated parts, stampings and castings, any size, in large or small volume.	100 to 600 mg per sq ft as a base for paint.	Surface is degreased and/or acid or alkali cleaned; coating is applied by immersion or spray from 1 to 10 min.	Anchorite, Bonderite, Granodine, Metalcote 516, Meta-Bond.
Zinc-iron phosphate on iron and steel.	Nuts, bolts, screws, hardware items, ordnance material, etc. Large or small volume. Large or small work.	1000 to 4000 mg per sq ft. Oiled for rust prevention.	Surface is degreased and/or acid or alkali cleaned. Coating is applied by 20- to 30-min. immersion or spray.	Parco-Compound, Protectorite, Permadine.
Zinc-iron phosphate on steel.	Blanks and shells for cold-forming. Heavy stampings, tubes, rod, wire. Any size in large or small volume.	150 to 3000 mg per sq ft. To improve cold-forming, facilitate drawing and improve die life.	Pickling is necessary after annealing. Coating applied by immersion in 3 to 15 min.	Bonderite, Foscote, Granodraw.
Zinc phosphate on galvanized and other zinc and cadmium surfaces.	Corrugated galvanized structures, zinc alloy die castings, zinc or cadmium plated sheet or components; hot dip galvanized stock. Any size in large or small volume.	75 to 500 mg per sq ft. As a base for paint.	Surface is alkali, or solvent emulsion - alkali cleaned. Coating applied in ¼ to 2 min. by immersion or spray.	Bonderite, Galvaprep, Lithoform.
Amorphous aluminum and chromic phosphates on aluminum.	Large and small fabricated parts and primary aluminum products.	20 to 200 mg per sq ft. To bond paint and increase corrosion resistance. Thin coatings sometimes used on zinc and steel.	Surface is degreased or acid or alkali cleaned. Coating is applied by brush, spray or immersion. Time ⅓ to 5 min.	Alodine, Bonderite 700, Corrosol No. 6, Lyfanite, Metalcote 669.
Thin, hard complex ferro-ferric phosphate on iron, steel, zinc, cadmium or aluminum.	Fabricated parts in large or small volume.	25 to 90 mg per sq ft. To bond paint and increase corrosion resistance.	Precleaning sometimes necessary, but solution usually does its own cleaning, particularly when applied by spray washer. Can also be applied by immersion. Time 1 to 5 min.	Anchorite, CrysCoat, Duridine, Irco 127, Klem Kote, Macco Machine Cleaner, Minit Kote, Paintite, Parcolite, Phoscote, Prep-N-Coat, Redi-Paint, Surphos, Turco 1620, Turco W. O. 1.
Phosphoric acid base metal conditioners, usually containing organic solvents. Used primarily for cleaning but capable of imparting a slight phosphate film to ferrous metal and aluminum surfaces.	Large or bulky fabricated parts which cannot be processed by dipping or spraying. Smaller parts processed by immersion.	5 to 10 mg per sq ft. Used for cleaning, rust removal, and to improve paint adhesion and corrosion resistance of painted parts.	The materials are capable of degreasing and conditioning parts being processed. Applied manually to large or bulky parts; by immersion for smaller work. Time of treatment depends on conditions of work.	Deoxidine, Metalprep, Oakite Compound No. 33, Rustclean, Parco Cleaners.

* *Prepared from material gathered by the* MATERIALS AND METHODS *staff.*

coating materials, however, form protective coatings from baths of relatively mild acidity (pH about 4.5), thus permitting the incorporation of cleaning agents directly in the bath. These solutions, when used in power spray washers, function both as cleaners and phosphating materials, and, where soil is not too heavy, eliminate the necessity for precleaning stages. Coatings from such baths are smooth and continuous, in contrast to the more coarsely crystalline structures of the zinc-iron and manganese-iron phosphates, which are deposited from solutions containing free phosphoric acid.

In all metal treatments where the phosphate coating is to form a base for paints and lacquers, and frequently in treatments designed for corrosion protection by waxing or oiling, an acidified final rinse is recommended. Chromic acid, phosphoric acid, or mixtures of the two are used in dilute solution. These particular acids leave residues compatible with the majority of organic finishes and (especially the chromic acid) tend to supplement the phosphate coating and endow the surface with additional passivity. The pH of these rinses range from 3.0 to about 5.0. The acidified rinses also remove unreacted excess phosphating chemicals from the metal surfaces, neutralize and keep soluble the hard water salts present in rinse water, and insure that the residues left on the surface are not alkaline. Alkalinity beneath a paint film is almost always harmful.

Waxes Now Used to Process as Well as Protect Materials

by **KENNETH ROSE**, Western Editor, Materials & Methods

Four principal groups of waxes, available in many different forms, serve industry in a variety of ways.

● MANUFACTURERS HAVE RECOGNIZED the need for protective materials that will not interfere with visibility of the product, especially for point-of-sale protection of consumer items. Transparent packaging is one solution, and the use of transparent films such as clear lacquer or shellac is another widely used method. Industrial items can use this type of temporary protection also, for parts that must be protected before processing or assembly, or during handling in the plant.

The need for transparent protective coatings has widened the field of usefulness of the waxes, a group of materials used for this purpose for centuries. Industry has begun to realize that a thin transparent film of waxes, which have been used for hundreds of years to protect fine woodwork and leather, can be useful on metals, paper, rubber, and other materials. With the expanding of the range of applications has come an expansion of the family of waxes, so that today industry is no longer dependent upon a few natural materials, nor are applications limited to those in which a transparent protective film is the sole requirement.

The waxes compounded into these industrial materials can be classified into four groups as follows:

Animal waxes, such as beeswax, spermaceti and Chinese wax. Beeswax is used in furniture and floor waxes, adhesives, leather dressings, transparent paper, textile sizes and finishes, and in engraving. Spermaceti is used in textile finishes, soaps and laundry preparations, and in medicinals. Stearic acid, or stearin, is important in the compounding of rubber as a dispersing agent for carbon blacks, as a softener, and as an activator for the accelerators used in vulcanization; it is also used in soaps, shoe polish, metal polish and pharmaceuticals. Paper sizing, cotton fabric dressings, polishes for leather, metal and wood may use Chinese wax.

Vegetable waxes, such as carnauba wax, candelilla wax and bayberry wax. Carnauba wax finds use in waterproofing, in polishes, electrical insulating compounds, phonograph records and varnishes. Candelilla wax goes into polishes and dressings, varnishes, rubber compounds, adhesives and electrical insulating materials. Japan wax is used for polishes, soaps and in wax matches.

Mineral waxes, such as ozokerite, ceresin and paraffin waxes. Ozokerite, and the ceresin refined from it, are used as a waterproofing for electrical insulation, for rubber compounding, wood impregnants, waxed paper, carbon paper, lubricants, polishes, textile sizings, sealing wax and inks. Montan wax is used in electrical insulation, paper sizing, phonograph records, adhesives, paints and polishes. Paraffin wax goes into rubber compounding, packaging of foodstuffs and other products; for waterproofing of wood, paper, etc.; in electrical insulation, phonograph records, polishes, laundry preparations, and in chemistry and medicine.

Synthetic waxes. These can be modifications of the above, or can be wholly synthetic. A series of chlorinated waxes ranges from liquids to hard solids. They are used as lubricating oil additives, in cutting oils, as plasticizers in electrical insulation, and as ingredients in coatings for metals, plastics, wood, paper and fabrics. Microcrystalline waxes are used in waterproofing compounds, protective coatings and dressings, phonograph records, lubricants, electrical insulation and in inks.

Properties of Waxes

While the waxes show a considerable range in properties, a few general properties of industrial importance can be named:

1. Waxes are highly water-resistant and water-repellant. There are exceptions to this general statement. Some of the synthetic waxes are water-soluble. In the main, however, the waxes are insoluble in water, and this is one of their most important characteristics.

2. Waxes tend to be chemically inert. They do not corrode metals, nor attack wood, glass, rubber, paper, etc. They resist the action of most chemicals. Exception must be made for some of the synthetic waxes, which seem to be somewhat more active chemically.

3. Waxes are for the most part lighter than water, soften at temperatures only slightly above room temperature, are usually light in color and transparent when used as a thin film, possesses a characteristic luster, and are free from tackiness unless warmed. They are, in general, soft solids, but some synthetic waxes may be oily liquids.

4. Most waxes are not subject to putrefaction or rancidity.

5. Waxes are antifrictional. They are natural lubricants, and this property is becoming more important in a number of industrial applications.

6. They have good electrical insulating properties.

These properties make them important as waterproofing compounds; protective and preservative materials for wood, leather, metals and rubber; dry lubricants; heat sealable materials when used as finishes on paper for packaging; protective materials for electrical and electronic units; and ingredients for adhesives and rubber substitutes.

Forms of Waxes

Waxes are available as commercial preparations in the form of (a) solid waxes, (b) dispersions in water, (c) dispersions in hydrocarbon solvents, (d) dispersions in oil, (e) paste waxes, (f) solutions in hydrocarbon solvents. Solid waxes are applied in a molten condition for most purposes; they are used occasionally as bar waxes and applied by rubbing. Water dispersions are most used where protection and luster are the results desired. Dispersions in hydrocarbon solvents are used where lubrication is desired, as in metal cutting compounds, drawing compounds, etc., where heat is developed under pressure. Dispersions in oil, possessing excellent stability, have been developed especially for use as a lubricant in slow draws, where little heat is produced. They are used where initial lubricity is desired, or where a wet surface must be maintained; the oil provides these properties.

Paste waxes are usually thick dispersions in organic solvents, and are used where a thick film is required. They have found a special field in the lubricating of metal during spinning. Paste waxes, easy to apply, have been used as mold release agents also. Solutions of waxes in hydrocarbon solvents are the best choice when a continuous film is important, as for protective purposes over steel, aluminum, magnesium, brass and copper. The film produced is dry and lustrous.

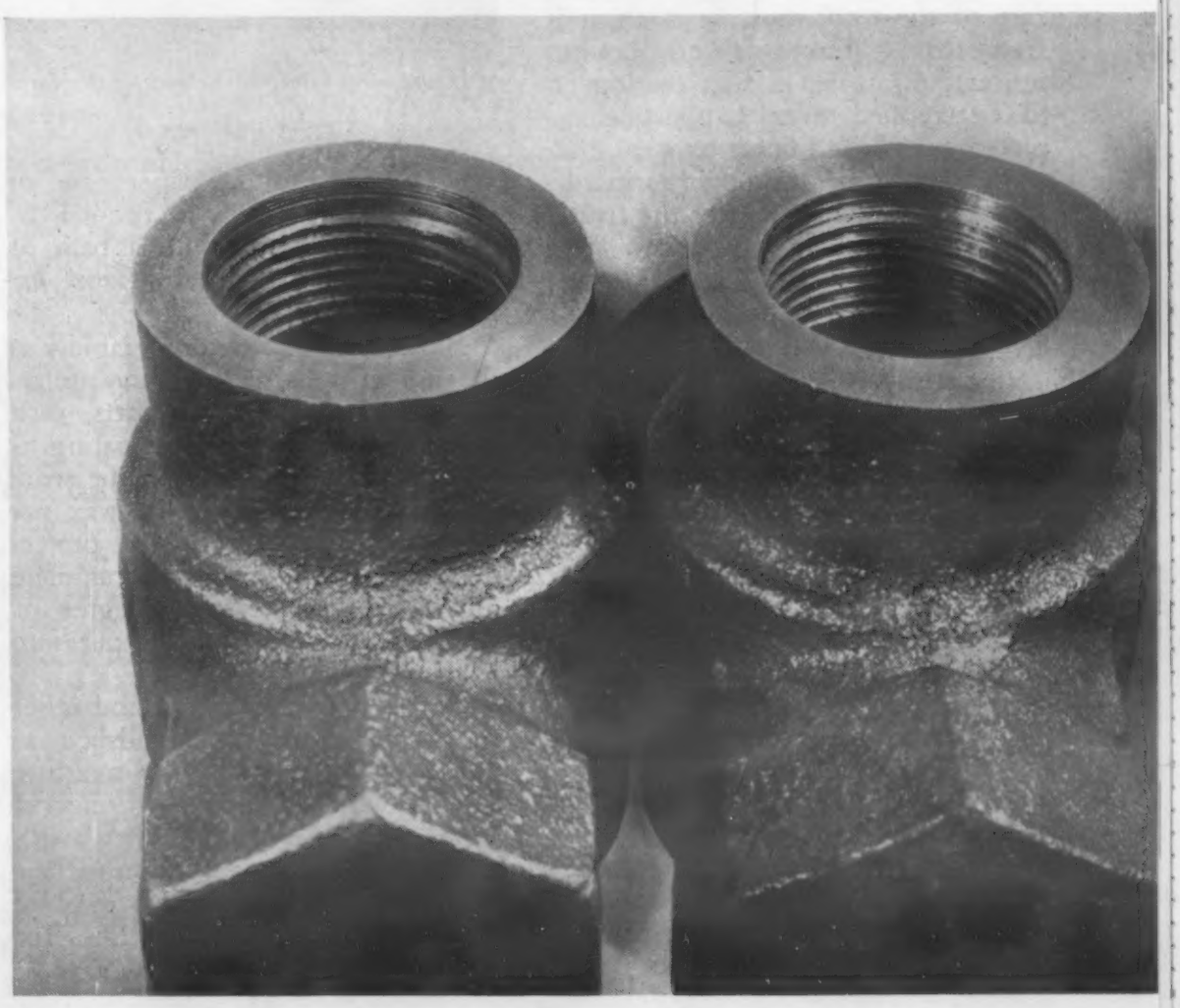
When used industrially, waxes of several kinds can be blended together to obtain a material with the desired properties. The properties of the finished material will be affected by the form in which it is prepared whether solid wax, dispersion, paste, or solution, and by the solids content. Other ingredients include synthetic or natural resins, corrosion inhibitors, stabilizers, and perhaps coloring materials, in addition to the solvent or dispersing medium.

The use of wax in the form of a dispersion makes possible low-cost coverage, as a gallon of the materials can be made to cover as much as 2000 to 2500 sq ft of surface. Dispersed waxes are applied by spraying, dipping, wiping, roller coating or tumbling. Spraying is done by hand or automatically, and an even coating can be laid down that will dry rapidly. Water dispersions are especially suitable for spray application, as they do not present a fire hazard. Making several passes over the surface will improve gloss. A bank of lights or warm air oven will accelerate drying where necessary.

Dipping can be done on a belt conveyor or in baskets. The parts can be warmed before dipping if the cycle must be short, and a forced drying after dipping is the rule. Infrared drying or warm air drying are the methods most used. When basket dipping is used, the parts may be centrifuged before going into the drying portion of the cycle to insure removal of all excess fluid, and to develop a uniform film.

When only one surface of a part is to be coated with wax, or when the application does not warrant setting up of elaborate equipment, the wax may be applied by simple wiping. It is most easily used with flat

Wax preparations were used to lubricate in tapping the cast iron piece on the right. Threads were much cleaner than those on the piece at left, and required less power to make. (All photos courtesy S. C. Johnson & Son, Inc.)



surfaces, but wire can be coated by the wiping method of passing it between saturated rubber sponges.

Roller coating is especially valuable for coating flat surfaces, such as sheet stock. A web of cloth or paper can be passed between two rolls to coat both surfaces at high speed and in continuous operation. Tanks to feed the wax dispersion to the rolls makes the process automatic.

Coating by tumbling is especially suited to coating small parts of irregular shape, and is widely used with articles of molded rubber, plastics or wood. Sawdust, shoe pegs, or leather scraps are impregnated with the wax, which can be applied as a solution, dispersion or in the molten state, and the parts to be coated are then tumbled in barrels with the impregnated material. The parts may be tumbled without the impregnated material first, to remove flash or burrs; after cleaning, the parts are then tumbled with the impregnated sawdust or scraps.

Most of these processes are especially effective with water dispersions of wax. Water dispersions can be used effectively with the work at slightly elevated temperatures. Large installations, where a considerable quantity of work goes into a dip tank or container at 160 to 180 F, may require the placing of cooling coils in the tank to prevent the dispersion from overheating. The surface of the work must be clean and free from grease or oil before processing. When a wax coating is to be applied over a phosphated, plated or oxidized finish on steel, the work should be thoroughly rinsed, then wax-coated soon after the treatment.

Wax dispersions in water are usually slightly alkaline in reaction because of the stabilizing chemicals in the dispersion. They are therefore miscible with soap solutions. A galvanized tank should not be used for dipping operations or storing the dispersion, however. A black steel tank is best.

It is possible to extend the wax dispersions in water by diluting with water. Some dilution should not be excessive, as it lowers the ability of the dispersion to wet the work, and detracts from the gloss finish.

Applications of Wax

Protective Films—Transparent wax films can be formed on steel, whether in a mill finish or plated, phosphated or oxidized. Wax preparations for this purpose contain a resin, as the wax alone would have inadequate protective properties. Water dispersions containing a black dye are especially designed for use with phosphated or oxidized finishes.

Wax films are also serviceable on nonferrous metals, such as aluminum, magnesium and the cuprous alloys. Wax polishes for wood and leather are standard. They are also widely used for protecting or glossing the surfaces of rubber and plastics. As a coating or impregnant for paper and textiles, wax supplies a high degree of water resistance without destroying the flexibility, or "hand," of the material. It is used as a wood impregnant also. In electrical insulation it serves to maintain high dielectric properties in paper, fiber, etc., by excluding moisture. Tropical packaging has made use of wax-coated wrapping papers, and of heavier layers of wax formed by dipping small parts into a bath of molten wax, to protect against extreme humidity.

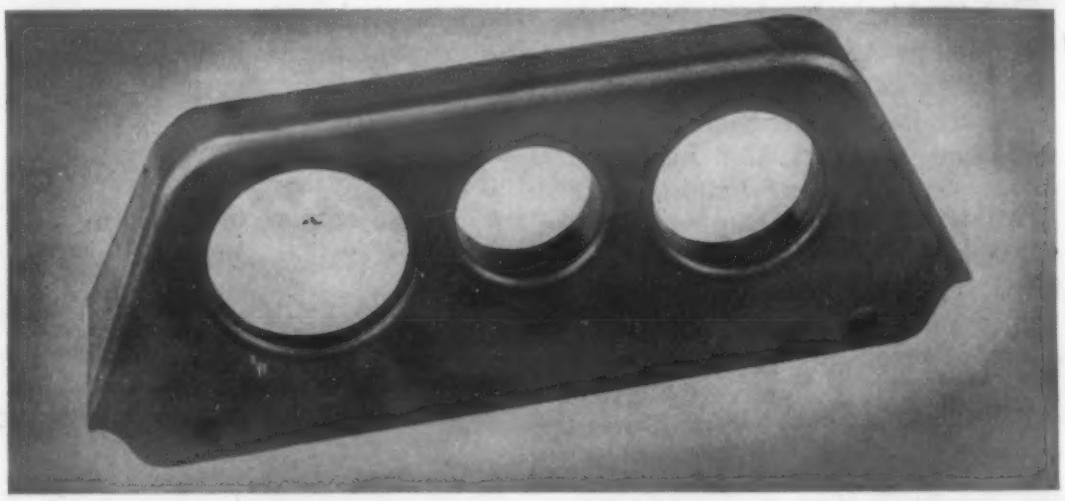
A field now expanding rapidly is the use of wax coatings for protection of small machined parts, such as nuts and bolts. The coating is produced by dipping, with the work in wire baskets. Here the wax not only provides a transparent protective coating that does not accumulate dust, but it possesses a degree of lubricity when the part is put into use.

Wax films on furniture and other woodwork are well established as protecting barriers against moisture and producers of high-gloss finishes. When wood is impregnated with wax, as in hardwood flooring, the durability and resistance to dirt are greatly improved. Wax polishes for leather are likewise familiar.

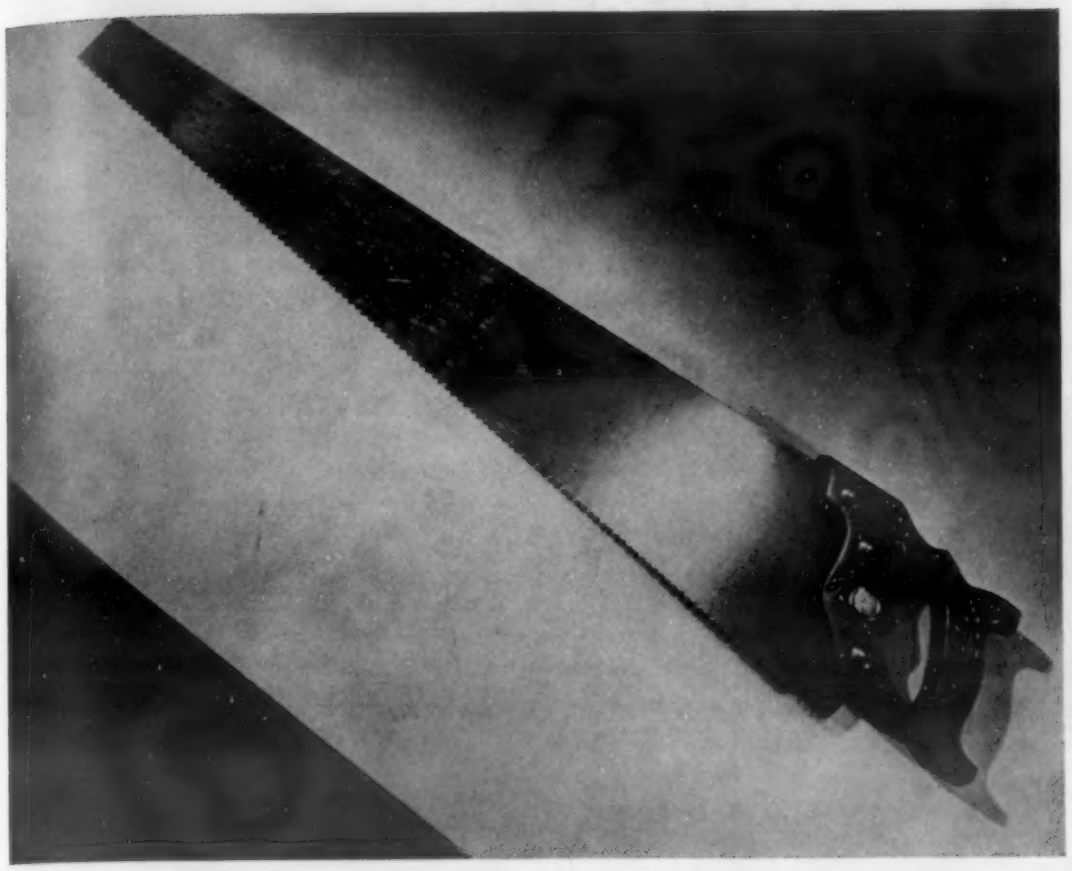
Molded plastic pieces are given an improved luster and increased resistance to scratching by a wax finish. Plastics so treated include clear acrylics and opaque thermoplastics and thermosets. In the case of the acrylics, it is necessary to choose the wax preparation carefully to avoid solvent action on the clear material by organic solvents in the formulation. The crazing or other surface defects may appear only after a lapse of time. Fountain pens, telephone handsets, radio cabinets, etc., are typical of the parts that may be given a wax finish. The finish is applied by tumbling, or by dipping, usually in a wire basket. Wiping or spraying may be used where suitable.

Puzzles and games, playing cards, cutout toys, and other paper and fiberboard items are given longer life, greater resistance to staining and wear, and a lustrous surface by a wax treatment. Roller coating is usually preferred, but dipping or spraying can be used. Carbon paper uses waxes for suspending the transfer ink. The water-resistant papers used for drinking cups, paper milk containers, soda fountain cups and plates, are made with wax sizing or are impregnated with molten wax after forming.

Special wax finishes for rubber are obtainable in uncolored and colored types. Black finishes can be made with a black dye or with a black pigment, the opaque pigment being the choice for maximum protection against sun-checking and oxidation. Wax finishes give a gloss to such rubber pieces as rubber tile, rubber heels, toilet ware, rubber-covered wire, toys, industrial hose, gaskets, battery boxes and stair treads. Waxes are also used as mold release agents. The finishes can be applied by spray-



Wax drawing lubricant helped in the forming of this coin plate for a pay telephone made of 405 stainless steel.



This saw blade was held for 48 hr at 100 F in an atmosphere of 100% relative humidity. Corrosion started in the untreated portion of the blade, while the wax-protected portion remained unaffected.

ing, dipping, wiping, or roller coating, depending upon the shape of the piece to be coated.

Textiles, and especially cotton and linen, may be given a wax dressing to improve the hand and to impart a measure of water resistance. Artificial leathers are given a gloss and more leatherlike appearance by wax dressing.

Protective films of wax on steel are not intended to provide long-life protection against outdoor exposure, nor in service involving abrasion. They will give good protection during storage and counter display against finger-spotting and other defects caused by handling. With the nonferrous metals, where a certain amount of corrosion resistance is inherent in the metal, wax films will give satisfactory outdoor service.

An important new use for wax preparations as protective films is in the protection of bright-finished tools such as saws during shelf period. The transparent film protects against both atmospheric corrosion and finger marking, and need not be removed before use of the item. Several of the large mail order houses are now using this method of protection.

Aluminum window frames and screen sash have been tested in 20% salt spray in accordance with A.S.T.M. methods. The aluminum frames coated with the wax film were undamaged after more than 300 hr in the salt spray, while the unprotected frames were badly corroded after the same exposure.

Lubricants for Metal Processing—In metal cutting, deep drawing, cold heading and wire drawing, benefits from the use of wax dispersions and solutions are just beginning to achieve recognition. Their use as a dry lubricant in automobile leaf springs is well established. More recently wax has become established as a lubricant in certain powder metallurgy products. Aluminum slugs for impact extrusion into collapsible tubes can be coated with a wax film, usually by dipping, to lubricate the forming operation.

Certain synthetic waxes have been used for some time in cutting oils to improve the wetting action of the oil. Use of blended waxes as lubricants for drawing, tapping, bending, and other metalworking operations is new, however. Tests made in the tapping of a 1½-in. hole in cast iron, using wax in comparison with a standard cutting oil, showed that cleaner threads were produced with the wax as lubricant, and that power required was less.

As a drawing compound, especially formulated waxes have shown unusual results. A light-gage stainless steel, type 405, was drawn to form the coin receiver panel for a pay telephone. This involved drawing three holes about ½ in. deep over a small radius. Not only were the pieces drawn successfully, using a solvent dispersion of wax as the drawing compound, but tool wear was reported to be imperceptible after 2000 pieces had been run.

Results of metal forming tests at an aircraft plant were favorable. Aluminum tubes of 3S alloy 4 in. in dia, one set with a wall thickness of 0.065 in., another with a wall thickness of 0.081 in., were bent on a power bender. The first set was bent to a radius of 15 in., the second to a radius of 8 in. Wax lubricant was applied to the outside surfaces of the tubes by brushing, while regular lubrication was used on the insides of the tubes and on the arbor. The tubes were formed smoothly, with no wrinkling on the inside walls of the tubes.

In addition to performing successfully as a die lubricant, it was reported that the wax coating produced savings by replacing the protective coating of grease applied before storage, and the consequent cleaning necessary before forming the aluminum. The lubricant used was a solvent dispersion of waxes, and the film was about 0.0005 in. thick.

In making the bending tests, wax was applied to the aluminum, permitted to dry for about 8 to 10 min, and the pieces were then bent dry. No additional lubrication was necessary, it was reported. Progressive draws can be made without applying a second coating of wax, unless an anneal is also necessary. The process holds out the possibility of clean and oil-free operations, according to engineers of the company.

Ingredient in Compounded Materials—Waxes go into the compounding of rubber, where they serve as a dispersing agent for carbon black, and as an activator for the accelerators used to speed vulcanization. They are frequently used in formulating adhesives, pharmaceuticals, phonograph records and printing inks. They are also used in paints to improve gloss and water resistance.

Wetting Agents—Certain of the chlorinated waxes have the property of improving the ability of lubricating oils to wet steel, and are used as additives with crankcase oils for that purpose.

Low-Temperature Fusing Constituents—Waxes provide fusible patterns for use in the precision investment casting process. They confer heat-sealing properties upon wrapping papers, such as bread wrappers. They also serve as thermolytic binders in powder metallurgy compacts.

Materials at Work

Here is materials engineering in action . . .

New materials in their intended uses . . .

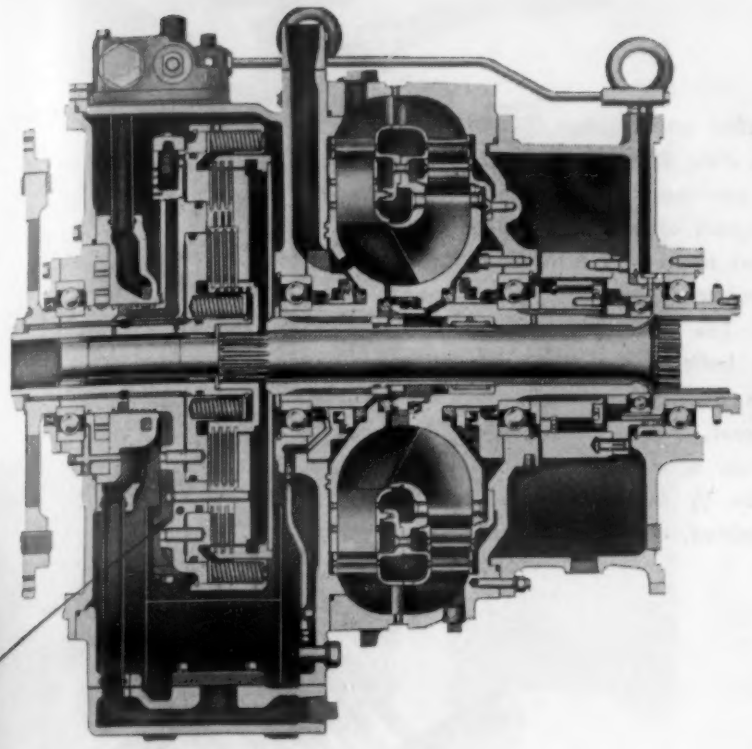
Older, basic materials in new applications . . .

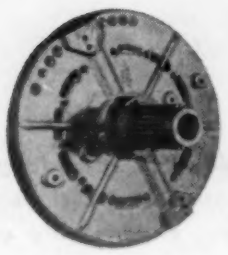
NEOPRENE WINDOW SEALS

The J. B. E. Olson Corp. of New York had a tough design problem in this glass-paneled delivery truck. The catch in this special truck body was mounting the glass in the frames. The mounting had to be firm to prevent chatter, yet it could not be so rigid that the normal twisting of the body would crack the glass. It had to give a tight seal, without transmitting road shock. Thermal insulation had to be met, too—each panel was two panes of shatterproof, plate glass with a dead air space between. The sketch shows the answer that the Olson designers came up with. An extruded aluminum double-channel is riveted to the body and carries two Neoprene strips which lock the glass in place, seal the edge, and allow the body to twist without breaking the glass. Either of the panes can be removed from its Neoprene mounting strip. Neoprene was chosen over other rubbers because of its high tensile strength and its resistance to sun and weather. Gasoline fumes and chemical cleaners that might be used on the glass or truck body will not soften it, either.

PLASTICS IN ELECTRIC MIXER

Several parts of this all-purpose electric mixer, made by Manning, Bowman & Co., are molded of Durez phenolics. Heat resisting Durez is used on the handle, speed-control button and on several smaller parts. Its shiny black surface contrasts with the white finish on the rest of the mixer. The handle can be mounted on the top or on the side, as preferred, so that the mixer is convenient for right or left hand use. This reduces the possibility that the operator's hands will be burnt by steam or hot food. The three-speed switch is turned by hand, using molded-in grooves along the outer edge. It is put at the top of the mixer and clearly marked for the various speeds. Speed stops are highlighted in white.





DUCTILE IRON CLUTCH

A new application of ductile iron, which derives its unusual properties from the occurrence of graphite in spheroidal form instead of flakes, is in heavy duty clutch parts. The Twin Disc Clutch Co. manufactures torque converter transmissions which use these clutches (arrow in cutaway). The part is designed so that it could not be forged out of steel. Cast iron, on the other hand, would not stand up under the severe service. Thus, ductile iron was a logical choice from a strength standpoint. It had other advantages, too. The iron is easy to machine. As the front and rear views show, the clutch carrier has a hub and a large flange, the casting measuring 17⅜ in. in dia at the flange vein and ¾ to 1 in. at the hub, the part is machined overall, and splines are cut in the hub. Almost every possible machining operation, including threading, hobbing, drilling, reaming, tapping, milling, boring and turning, are performed on the casting, and appreciable economy results from the use of ductile iron. Castings were produced by the State Foundry Machine Co., Cedar Grove, Wis.

BI-METAL SWITCH

Seven copper alloys are used to resist corrosion in this switch made by Camstat, Inc., Los Angeles, Calif. Cartridge brass, 70 copper, 30% zinc, is used for the cover (1), bracket (2), pointer (4), yoke (9), and staple (3), because it takes heavy working better than high brass. Half-hard temper was necessary to permit drawing, forming and bending of the cover pointers and yoke, and in the staple to permit the prongs to be bent at assembly. The bracket is spring hard (8 numbers) since it acts as a flat spring. Phosphor bronze Grade A, 95 copper, 5 tin, 0.15% phosphor is used for the contact springs (16), push button spring (17), spring link (18), and flat spring (20). All have spring temper. Grade B nickel silver, 55 copper, 18% nickel and the rest zinc, is used in the pivot bracket for its spring characteristics, high strength (over 90,000 psi in its extra hard temper) and ductility to permit forming. Grade A nickel silver, 65 copper, 18% nickel and the remainder zinc, has greater ductility and permits dimpling, bending and forming the actuating lever (10). Free machining brass is used in the counterweight (on 9), adjusting nut (5), terminal (6), stub (7), and calibrating screw (12). The hollow rivets (11) and (13) are cold headed from cartridge brass, while the cold headed and roll threaded screws (14) and (15) are made of high brass, 65 copper, 35% zinc. This alloy is not as ductile as cartridge brass, but is sufficiently workable for medium-sized heads and roll threading.

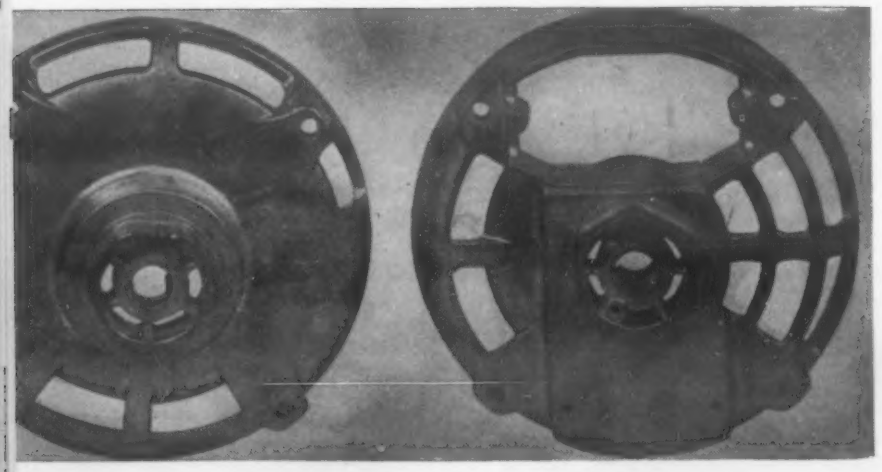
Materials at Work

NYLON HAMMERS

The Nuplaflex and Nuplan (nylon) tips used in the Nupla Hammers made by the New Plastics Corp. give a tough striking surface that is resistant to petroleum and common industrial acids. The plastic tips will not chip, spark or mushroom. The resiliency of nylon is low and the new hammers have very little of the rebound or bounce that is pronounced in rubber tips. Hammer rebound is claimed to reduce operator efficiency. The tips can be changed to suit the requirements of each job. Some indication of the superiority can be seen in industrial tests. In one application, the nylon hammer lasted 500 hr; its nearest rival, brass, lasted only eight. Another check on the comparative yearly costs of nylon and rawhide hammers showed nylon a little more than 1/3 as expensive. The illustration shows a nylon hammer, disassembled, next to the darker, assembled rawhide hammer.

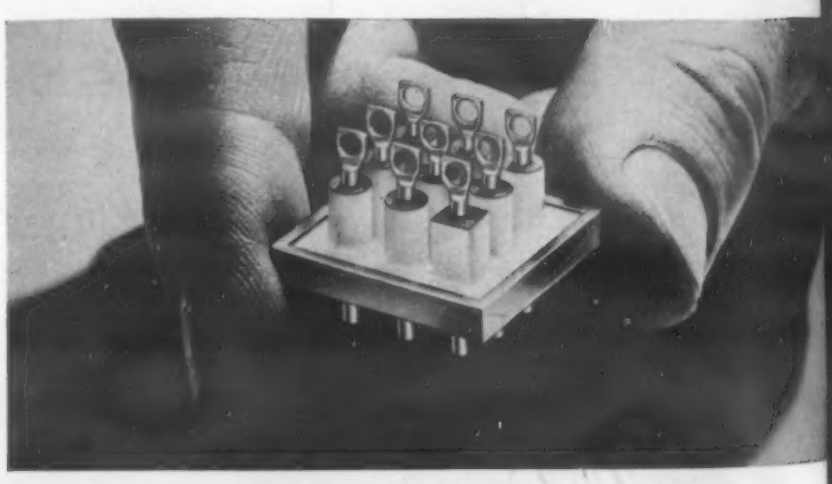
WEIGHT ESTIMATING SLICER

The Toledo Scale Co. designed its new Profit-Angle Slicer with Quick Weight Estimator for five characteristics: good looks, convenience, dependability, safety, and cleaning ease. The choice of the material for each part was an important part of the design. Every part of the machine which touches food is stainless steel or anodized aluminum. This precaution insures easy cleaning, and adds to the beauty of the machine besides. The cleaning problem was also lessened by designing all parts that are cleaned with smooth lines to prevent dirt pickup. The circular knife is one piece of stainless steel, double-angle mounted so that only the leading edge of the knife comes in contact with the food. The knife guard has a flat top to allow full travel to the carriage, and there are no channels or crevices inside the guard to collect meat juices or scraps. The body of the machine is Bonderized and finished in baked enamel.



DIE CAST END FRAMES

The Small Motors Div. of the Westinghouse Electric Corp. has reduced the cost of the end frames for fractional horsepower motors by an estimated 20% by changing from iron sand castings to these aluminum die castings. The biggest saving is in machining. The 11 machining operations required on the iron castings were reduced to three. Before changing to die casting, the frames were completely redesigned to take advantage of the economies of the process by the Light Metals Div. of Thompson Products, Inc., in cooperation with Westinghouse engineers. The new design incorporates such features as bosses around throughbolt holes to reinforce the castings against compressive stresses applied during assembly. Tapping operations were eliminated by using thread-cutting screws in cored holes, and a hexagonal shoulder was added to act as a locating base for fixtures.



TEFLON TRANSFORMER TERMINALS

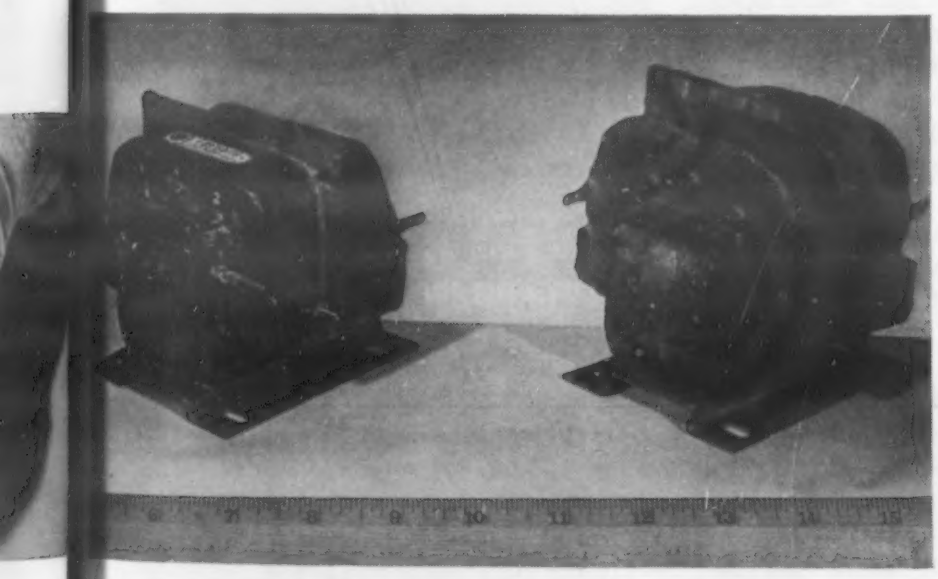
The United States Gasket Co. is producing a fused hermetic seal between fluorocarbon resins and metals in the one- to nine-pin Chemelec transformer terminals. These terminals are used to hermetically seal AF, AG, AH and AJ size transformer cases in specification MIL T-27. The fluorocarbon-metal seal structure is microcrystalline and the material changes evenly from pure fluorocarbon to pure metal in a cross-section through the seal. These terminals stand vibration and mechanical and thermal shock well, due to the nature of the seal and the characteristics of Teflon. There is no strain point as there is in a fused glass or ceramic-metal seal. The assembly of the unit is also facilitated because there is no danger of breakage. The terminals are used from 150 to 525 F without changing their electrical characteristics. Teflon is also unaffected by even extreme humidity, is non-inflammable and impervious to corrosive atmospheres and fungus.

WHIP CREAM DISPENSER

The new Araldite coating resin developed by the Ciba Co. prevents the destructive action of fatty acids on the aluminum containers of cream whipping machines. This corrosion problem had shortened the service life and marred the appearance of previous machines. The solution to the problem, as worked out for the Kidde Manufacturing Co., the machine manufacturer, was to pour the resin developed for the purpose into the aluminum bottle, pour off the excess, and allow the resin that stayed on the inside surface to harden. This coating made the aluminum impervious to the fatty acids in the cream and simplified cleaning problems. Thus, the lightness of aluminum could still be capitalized on, and the expense of a more corrosion resistant metal was made unnecessary.

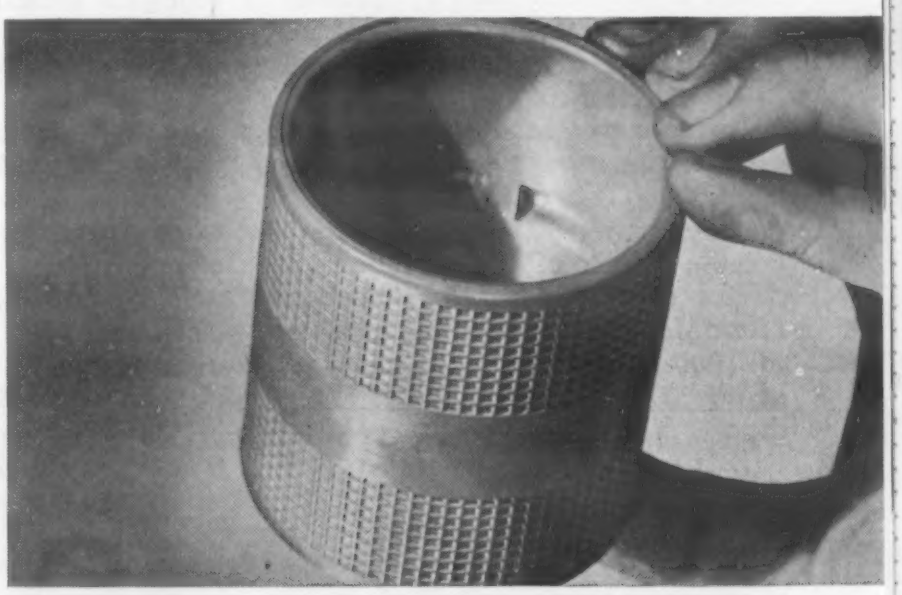
NYLON BEARING

Nylon as a bearing material performs well under adverse lubricating conditions or with no lubrication at all. It is tough, resilient, abrasion resistant, inert to most industrial chemicals, and stands temperatures up to 250 F. The tough glazed surface that forms on nylon gives low friction and wear, and the plastic tends to damp vibrations. Dimensional changes due to heat and moisture absorption required wide clearances in conventional nylon bearings, however, and the bearing loading approached a line contact. The Thomson Industries, Inc., Manhasset, N. Y., have designed the Nylined bearing to remedy these defects and capitalize on the advantages of the material. This bearing consists of a metal shell, with a nylon liner that is cut with a corkscrew compensation gap. This gap allows the nylon to expand and contract without changing the radial dimensions of the bearing. Lubricant can be stored in annular grooves in the metal shell. Nylined bearings, unlike regular nylon bearings, can be press fit or clamped easily, and there is no danger of seizure due to deformation of the nylon. There is also a material saving, since nylon is provided only for bearing, while the strength is in the steel shell.



HIGH PERMEABILITY ALLOY

An aircraft radar power transformer made with Tran-Cor T-O-S, an alloy developed by Armco Steel Corp. (at the left), is smaller and lighter than a similar unit of equivalent rating made with standard material. Core loss of T-O-S is low, but the outstanding characteristics of the material is its high permeability at very high inductions. It is believed that no other commercial silicon or nickel alloy will meet the permeability limits of T-O-S, 1800 at 18 kilogausses. The new material was designed for ambient temperatures of 390 F. It is an iron-silicon alloy with a high degree of orientation, obtained by special processing and test-selection. T-O-S was developed under contract for the Navy for use in miniaturized equipment with 400-cycle current. It is supplied only in four mil thicknesses in 12⅜-in. wide coils, and has excellent workability.



YARN-CARRYING SLEEVE

The United States Rubber Co. has developed a tough plastic yarn-carrying sleeve for use in textile mills on Barber-Colman spooling machines. The new parts are made of Uscolite, a thermoplastic blend of rubber and plastics. One mill can have 30,000 to 50,000 of these sleeves in operation, and replacements have run as high as 15% per year. The plastic sleeve is expected to greatly reduce this maintenance expense. The new part has more than five times the impact strength of the phenolic types now being used. It will not shatter or warp, according to the manufacturer, nor will it chip at the edges to break or knot the yarn. The Uscolite sleeve can be used with cotton, rayon or the newer synthetic fibers spun on the cotton system. A waffle design on the surface permits it to carry yarn more securely.

High Chromium Steels esist Attack by Liquid Bismuth Alloys

by **JOHN L. EVERHART**, Associate Editor, Materials & Methods,

and **EDGAR L. VAN NUIS**, Metallurgical Engineer

A major problem in the use of liquid metals as heat transfer media is the selection of suitable constructional materials to contain them.

● IN MANY INDUSTRIAL processes efficiency is increased by elevating temperatures. A limiting factor is the manner of heating the reaction vessel or of transferring heat from one piece of equipment to another. Steam is commonly used at relatively low temperatures, but the increase of pressure with rising temperature limits the range of economical operation. At somewhat higher temperatures organic liquids or molten salts are employed. The organic liquids are not used above 800 F to any extent because the rate of decomposition increases rapidly above that temperature. Molten salt baths are used up to 1000 F and can be applied at higher temperatures, but their heat transfer properties are not particularly attractive and corrosion becomes a factor as the temperature is increased. Present investigations now indicate that metals will be employed to extend the useful range of liquid media to 800 to 1400 F and possibly to higher temperatures.

The liquid metals have certain definite advantages as heat transfer media. They have high thermal conductivities. Their heat transfer coefficients are among the highest known, being many times those of the organic liquids. They do not decompose, a factor which limits the range of the organic compounds. Most of the metals under consideration have high boiling points, thus permitting operation of equipment at relatively low pressures. Electromagnetic pumping is possible, simplifying the pumping problem considerably by eliminating moving parts and packing. On the other hand, these liquid metals may be quite corrosive toward constructional materials.

Among the metals under consideration are mercury, sodium-potassium alloys, and bismuth alloys. Mercury has been used in boilers since 1922, and several new installations have been made recently. The maximum economical service temperature is limited to about 1000 F because of its low boiling point. The sodium-potassium alloys have low densities and their heat transfer properties are attractive. They have been used successfully in a number of heat transfer applications. These alloys, however, are hazardous in the event of equipment failure since they react violently with water, ignite spontaneously in air at high temperatures, and ordinary fire-fighting equipment is not suitable for extinguishing an alkali-metal fire. The bismuth alloys do not have these disadvantages.

The properties of several of the bismuth alloys are shown in the accompanying table. Among the desirable features are the low melting points, particularly of the bismuth-lead-tin and bismuth-indium-lead alloys. Since these two alloys melt below the boiling point of water, thawing of frozen lines can be accomplished with boiling water or exhaust steam. The boiling points of the two alloys have not been reported but are certainly near that of bismuth-lead. Thus, these alloys are potentially useful over a wide range of temperature. In comparison with the sodium-potassium alloys they have the disadvantage of much higher density. Bismuth alloys may also have unusual expansion properties since bismuth is one of the few metals which expand on freezing. Although

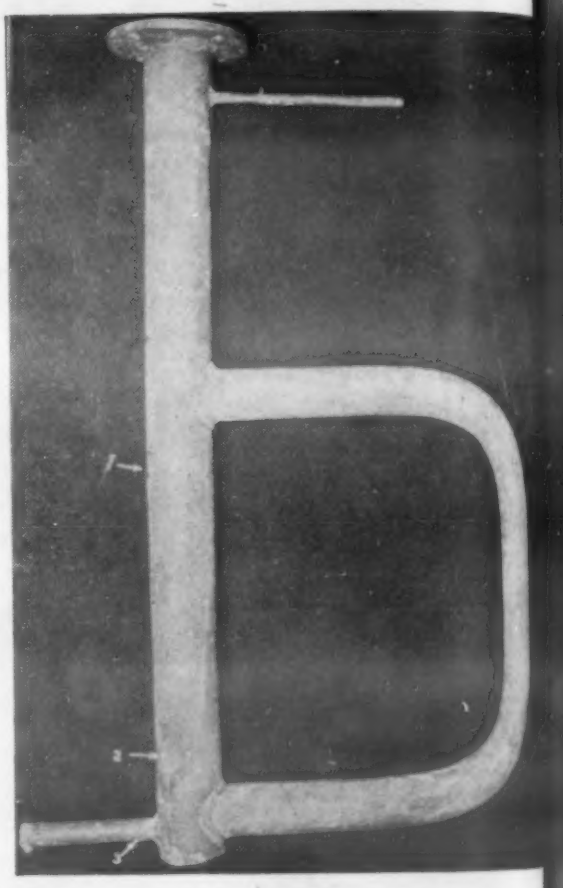


Fig 1—Corrosion loop showing locations of three failures. (1) After 1000 hr in contact with bismuth-indium-lead at 1200 F. (2) After 4000 hr in contact with bismuth-lead-tin at 1200 F. (3) After 4750 hr in contact with bismuth-indium-lead at 1200 F.

the alloys included in the table contract normally on freezing, both bismuth-lead and bismuth-lead-tin expand after solidification. This expansion would require consideration in designing equipment for handling the alloys.

The use of bismuth alloys in heat transfer applications depends on the selection of suitable constructional materials to contain them. Investigation of the rate of attack of bismuth-lead alloys on such materials indicates that nickel and high nickel alloys, copper and copper alloys, and cobalt alloys are unsuitable as containers.

Properties of the Low Melting Alloys

	Bismuth-Lead	Bismuth-Lead-Tin	Bismuth-Indium-Lead
Composition, % Bismuth	55.5	52	52.3
Lead	44.5	32	25.8
Tin	.....	16	.....
Indium	.....	.....	21.9
Density, Lb/Cu In.			
Solid 68 F	0.379	0.352	0.344
Liquid	0.371 (260 F)	0.346 (212 F)	0.337 (160 F)
Melting Point, F	255	203	158
Boiling Point, F	3038	.....	.....
Thermal Cond., Btu/Hr/Sq Ft/Ft/°F			
Solid	5.8 (100 F)	.....	.....
Liquid	6.3 (570 F)	.....	.....
Specific Ht., Btu/Lb/°F	0.035 (290-680 F)	.....	.....
Viscosity-Centipoises			
Liquid	2.28 (275 F)	2.58 (212 F)	2.29 (212 F)
Heat Transfer Coef., Btu/Hr/°F/Sq Ft	3700 (10 ft/sec)	.....	.....
Expansion, % on Freezing (Contraction)	−1.43	−1.53	−1.72
In Solid State	0.77	1.54	0

Among the steels, the high chromium alloys are more resistant than the nickel-chromium materials as a general rule. Little information has been available on the rates of attack of other bismuth alloys.

Corrosion Tests

In a series of investigations, a number of constructional materials were exposed to attack by several liquid bismuth alloys to obtain an indication of the corrosive properties of these alloys. Samples of the steels were submerged in the liquid alloys, which were circulated in a closed loop by means of convection currents set up by heating the main arm of the loop and cooling the side arm. Rates of attack were determined by weighing the measured samples before and after exposure. The results obtained in this series of tests are given in the accompanying table.

Since the loops, or "harps", as they are called more commonly, were built of type 309 stainless steel tubing, they were also attacked. Several failures occurred by pin-holing through the walls of containers, the locations of these failures being indicated in Fig 1. All of the failures occurred in harps containing bismuth-lead-tin or bismuth-indium-lead. Typical cross-sections of tubing after failure are shown in Figs 2 and 3. The nitric acid etch reveals zones with different etching characteristics. That these zones are not merely acid stains is shown in Fig 4, which is a macrograph of portions of the ring shown in Fig 3. The zones are clearly distinguishable in the unetched samples. The cracks which appeared during preparation of the section for polishing indicate that the material in this section was very brittle.

Harps containing bismuth-lead were still in operating condition when the tests were terminated. At that time, one had been operating for 5000 hr at 1200 F and another for 600 hr at 900 F. At the conclusion of the testing period, a harp containing bismuth-lead-tin was also in operating condition after 4000 hr at 1200 F.

In the "Liquid Metals Handbook," Kelman, Wilkinson and Yaggee have given a method of rating materials on their suitability for handling liq-

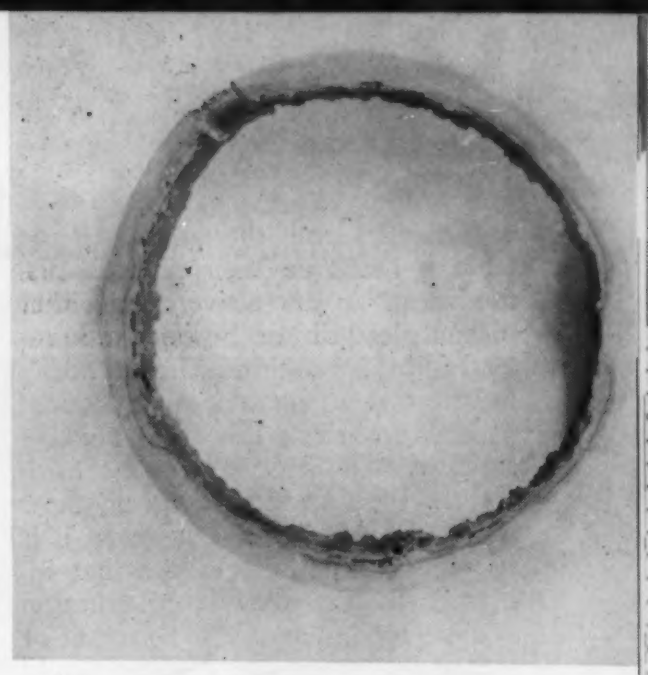


Fig 2—Cross-section of loop which failed after 4000 hr in contact with bismuth-lead-tin alloy at 1200 F. (Etched with nitric acid. 1½X)

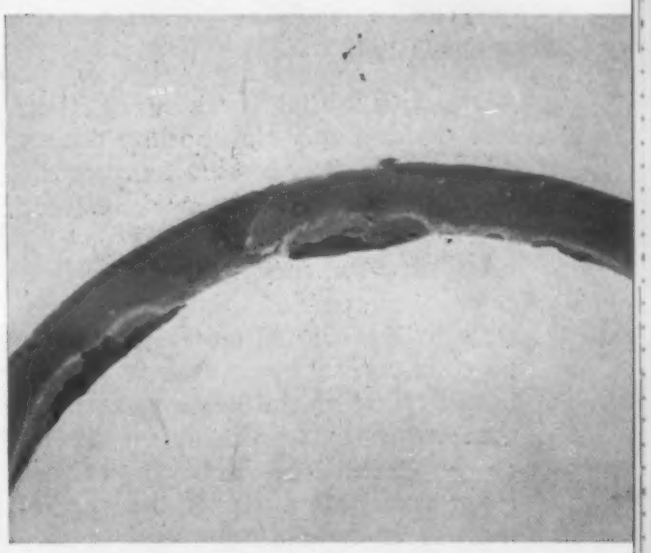
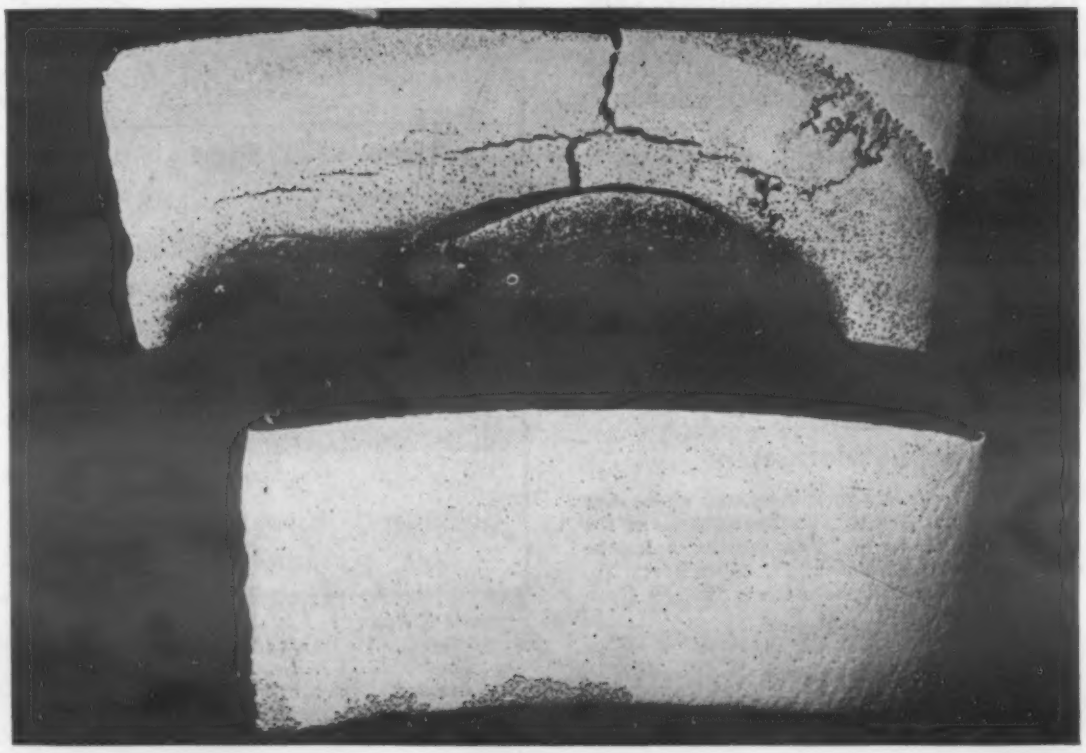


Fig 3—Portion of cross-section of a loop which failed after 1000 hr in contact with bismuth-indium-lead at 1200 F. Area of failure at top. (Etched with nitric acid. 4X)

Fig 4—Section of ring shown in Fig 3. Top, failure. Bottom, 1 in. from failure. (Unetched. 10X)



uid metals, and the accompanying table is based on their system. Bismuth-lead is less active than either bismuth-lead-tin or bismuth-indium-lead and there should be less difficulty in selecting a suitable constructional material to handle this alloy, but several materials deserve serious consideration for handling each of these liquid bismuth alloys. However, it is apparent from these results that resistance to one alloy is no criterion of resistance to another. Selection of a material to handle a given liquid alloy must be made on the basis of experiment with such factors as temperature, rate of circulation, and purity of the liquid alloy receiving due consideration.

Applications

Bismuth alloys, because of their low melting and high boiling points, can be used over a wide temperature range. They have been substituted for oil in heat exchangers because of their superior conductivity and heat transfer properties. Since it is possible to achieve extremely close temperature control by using a circulating liquid metal as the heating medium, these alloys will probably see service in the heating of high temperature reaction vessels either to add or remove heat, depending on the requirements of the process. Other uses which have been suggested are the control of die temperatures in die-casting machines, control of mold temperatures in glass making, fractional distillation of metallic vapors, and the reheating of steam.

Lest the low temperature possibilities be forgotten, bismuth alloys are used to impress finishes on fabrics. In this application, requiring close temperature control, the cloth is passed through a dye and then through the liquid bismuth alloy bath which provides the desired pressure to impress the finish on the fabric.

Present uses of the bismuth alloys in liquid form are quite limited, but their possibilities are great and they may be expected to serve useful function in providing suitable heat transfer media for many future applications.

Acknowledgment

The experimental work discussed above was performed in the Research Department of the American Smelting and Refining Co. under the direction of A. A. Smith, Jr. on contract No. AT (30-1)-884 with the Atomic Energy Commission.

Reference

Liquid Metals Handbook, 1st Edition, Washington, D. C., 1950.

Corrosion Rates

Constructional Material	Temp, F	Exposure Time, Hr	Liquid Metal	Rate of Attack, Mg/Sq Cm/Month	
				Polished Sample	"As Received" Sample
Stainless Type 304	900	1000	Bi-Pb	0.1	(a)
	1200	1000	Bi-Pb	7	18
	1200	1000	Bi-Pb-Sn	8	4
	1200	1000	Bi-In-Pb	0.6	2
Stainless Type 317	1200	1000	Bi-Pb	(a)	3
	1200	1000	Bi-Pb-Sn	..	64
Stainless Type 310	900	1000	Bi-Pb	0.2	0.4
	1200	1000	Bi-Pb	(a)	(a)
	1200	900	Bi-Pb-Sn	31	13
	1200	1000	Bi-In-Pb	90	71
Stainless Type 420	1200	770	Bi-Pb-Sn	31	17
Stainless Type 446	900	1000	Bi-Pb	(a)	(a)
	1200	740	Bi-Pb	0.4	(a)
	1200	1000	Bi-Pb-Sn	(a)	(a)
	1200	1000	Bi-In-Pb	15	12
Titanium	900	1000	Bi-Pb	119	96
	1200	1000	Bi-Pb-Sn	24	17
	1200	960	Bi-In-Pb	96	90
4% Chromium-Titanium	900	1000	Bi-Pb	(a)	(a)
	1200	860	Bi-Pb	232	166
	1200	1000	Bi-Pb-Sn	(a)	(a)
	1200	1000	Bi-In-Pb	26	6
Vanadium	900	900	Bi-Pb	(a)	(a)
	1200	1000	Bi-Pb-Sn	20	25
	1200	500	Bi-In-Pb	(a)	(a)

(a) Gain in weight

Rating of Constructional Materials

Conditions	Suitability for Service*		
	Good	*Limited*	*Poor*
Bismuth-Lead at 900 F	304 309 310 446 4% Chromium-titanium Vanadium		Titanium
Bismuth-Lead at 1200 F	309 310 446	304 317	4% Chromium-titanium
Bismuth-Lead-Tin at 1200 F	446 4% Chromium-titanium	304	309 310 317 420 Titanium Vanadium
Bismuth-Indium-Lead at 1200 F	304 Vanadium	446	309 310 Titanium 4% Chromium-titanium

* *Basis of Rating*

	Mg/Sq Cm/Month
Good	*Less than 1.6*
Limited	*More than 1.6, less than 17*
Poor	*More than 17*

Type 309 rated on basis of service as container for liquid metals.

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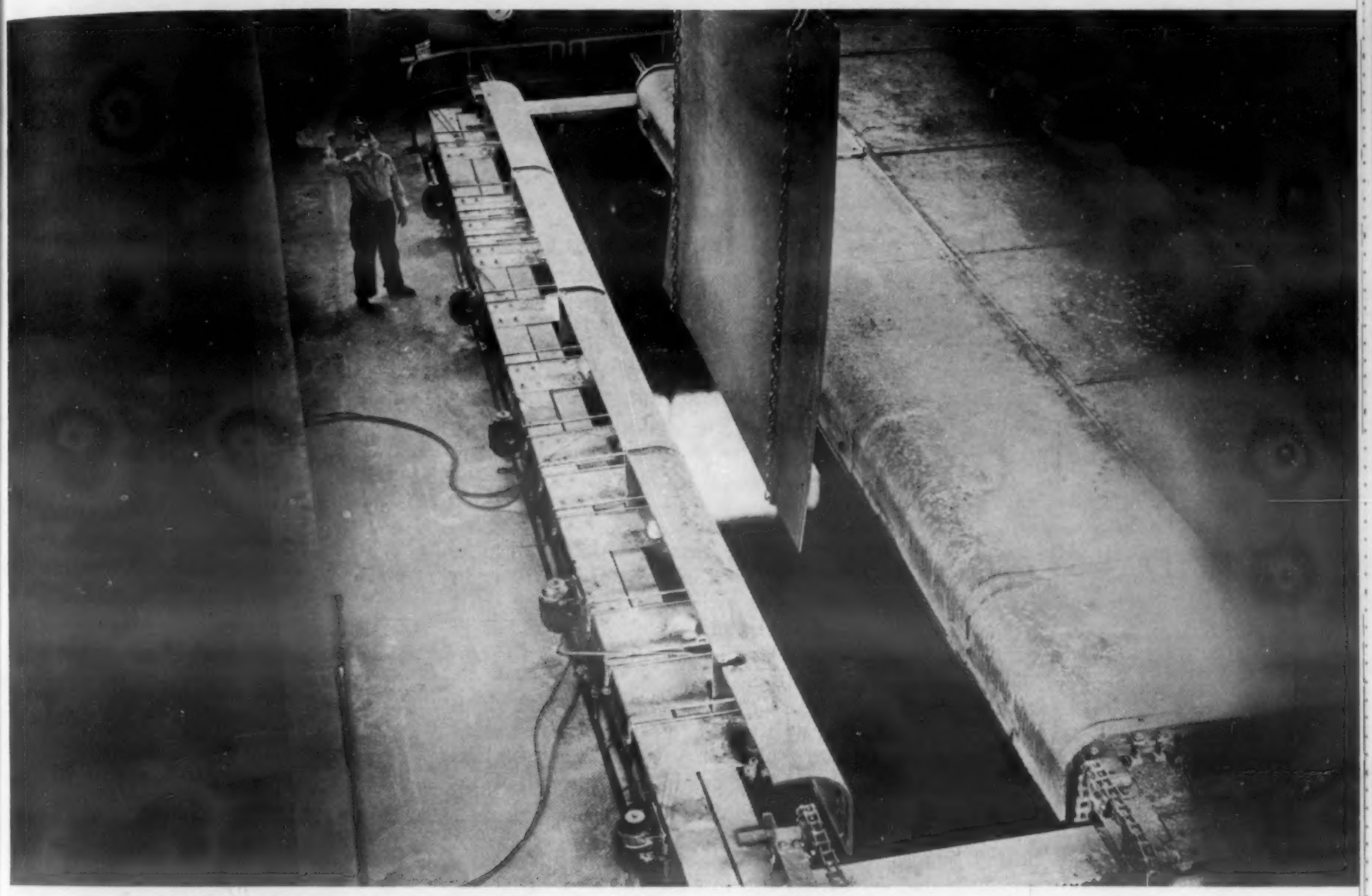


The largest salt bath ever constructed is 40 ft long, 6 ft wide and 11½ ft deep. This bath is used to descale stainless clad plate, which it handles at the rate of 30 tons per hr. (Ajax Electric Co.)

Salt Baths for Metal Treating

by Philip O'Keefe, Associate Editor, Materials & Methods

Every engineer who designs metal parts or specifies their heat treatment or heat processing should fully appreciate the advantages and the limitations of modern salt baths. Molten salt baths can be used for almost all heating and heat treating processes. This Manual is a guide for the practical man in selecting salts and equipment. It also gives design and operating information on the following important salt bath processes:

- ***Carburizing and Cyaniding***
- ***Neutral Hardening***
- ***High-Speed Steel Treatment***
- ***Isothermal Heat Treatments***
- ***Process Annealing***
- ***Tempering and Coloring***
- ***Heat Treatment Aluminum***
- ***Brazing***
- ***Cleaning and Descaling***
- ***Heating for Forging and Forming***

This is another in a series of comprehensive articles on engineering materials and their processing. Each is complete in itself. These special sections provide the reader with useful data on characteristics of materials or fabricated parts and on their processing and application.

In recent years the use of molten salt baths has advanced rapidly as a major heating and heat treating method. Although salt baths are not a cure-all, they have a number of unique characteristics which make them useful in many different applications. Their principal uses are (1) in heat treating processes either as a heating, case hardening or quenching medium; (2) heating metals for hot working operations or brazing; and (3) cleaning metals.

Fused salt baths operate at from 350 to 2400 F. The metal parts to be heat treated are dipped into the molten salt by hand in baskets or by conveyors. The primary purpose of the bath is to heat the metal to a predetermined temperature. This is done rapidly and evenly, and the operator can hold temperatures constant to within narrow-limits.

In addition to heating, salt baths may have other functions. They can impregnate the surface metal with carbon and nitrogen, or simply prevent decarburization during heating. The salts that a user chooses depend on the chemical effects that he wants as well as on the temperature at which he operates the bath. In any case a salt is usually chosen which melts at 200 to 600 F below the operating temperature.

Gas and oil fuel-fired pots are common for small salt baths. Larger baths are sometimes heated by gas-fired immersion tubes. Many operators also prefer electric resistance heaters for low-temperature baths. These methods are of minor importance, however, in comparison to the immersed electrode bath.

Salt baths, of course, are only one type of industrial heating. The most directly competing types are electric furnaces, controlled-atmosphere furnaces and induction heating. Years ago lead baths did many of the things now done by salt baths. However, lead baths are now fairly rare, outside a few special industries, and molten salts are almost universally used.

Advantages

The unique features provided by salt baths include the following:

1. *Surface Protection*—The salts protect the part from the air while it is being heated. Even when the part is taken out of the bath, it is coated with a film of salt which prevents oxidation. The operator needs no gas generating equipment; the only extra cost of this protection is the cost of the salt removed on the work.

2. *Automatic Preheat*—A crust of frozen salt forms around a cold piece as it enters the bath. This crust is an insulator which protects the part from thermal shock. The salt layer melts as the piece comes up to temperature.

3. *Rapid Heating*—A salt bath heats a part 4 to 6 times as fast as an atmosphere furnace. The metal is heated by conduction instead of radiation or convection.

4. *Uniform Heating*—Heat is conducted to all surfaces simultaneously from the molten salt. No surface is shaded.

5. *Buoyancy*—While all the common metals sink in salt baths (the salts are 1½ to 3 times as dense as water), the parts are still well supported. A 1-lb piece of steel weighs 0.6 lb in barium chloride at 1800 F, for example. A hot piece will not sag and distort as much in a salt bath as it will in air.

6. *Production Efficiency*—Salt bath furnaces take up less floor space for a given output than competitive equipment because of their shorter heating cycles. The temperatures and the furnace chemical conditions are easy to control in a salt bath; only unskilled labor is needed for efficient regulation. Salt baths are also easy to mechanize, and the work conveyors do not pass through the hot zones.

Limitations

Some undesirable characteristics must also be considered. These include:

1. *Operating Hazards*—Some hazards exist with salt baths that are not connected with competitive processes. Carbonaceous material should never go into nitrate baths, for example. Work for any bath must be dry—water turns to steam at bath temperatures and can cause dangerous spattering.

2. *Additional Processing* — More processing is often required with salt baths. The preparatory and post-treatment cleaning operations can be increased.

3. *Limited Range*—No one salt can be used for the whole salt bath temperature range. A furnace is limited to the temperature range of the salt in it. Most salt mixtures have a working range of 600 F.

4. *Work Shape Limitations*—Some pieces cannot be treated easily in a salt bath—either because they float or because they drag out too much salt due to recesses and undercuts.

Heat Treating Metals in Salt Baths

Any heat treating operation that can be performed above 350 F and below 2400 F—hardening, annealing, quenching, tempering, normalizing, martempering, austempering, isothermal heat treating, stress relieving and the like—can be done in a salt bath.

The main salts used in these operations are alkali metal chlorides, carbonates, nitrates and nitrites, and alkaline earth chlorides. Their action is fundamentally different from that of the carburizing salts. The carburizing salts react chemically with the metal surface, while the heat treating salts ideally have no reaction with the heated metal. Their only function is to bring the work to the bath temperature.

Heat treating salt baths can be divided into three classes according to operating temperature range:

1. 300 to 1200 F. Used for tempering and coloring steel, for annealing nonferrous metals, and for quenching.

2. 1100 to 1800 F. Used for annealing and hardening ferrous metals.

3. 1850 to 2350 F. Used for heating before forging, for hardening tool and die steels, and for heat treating stainless steels.

While the salt bath case hardening treatments have grown steadily through the years, a much more phenominal growth has taken place in straight heat treating applications. In steel mills, in tool rooms and in metal fabricating, some of the most important metallurgical advances in

Automobile ring gears are neutral hardened in batches in this circular fuel-fired pot furnace. (Surface Combustion Corp.)

the last 15 years have been made possible by the application of salt baths. These heat treating applications are still growing rapidly.

Neutral Hardening

Neutral salt bath hardening develops desirable physical properties in carbon and alloy steel parts without deleterious scaling, decarburization or pitting. Salt bath heating in the temperature range of 1400 to 2000 F, followed by a water, oil, air or low-temperature salt bath quench, can be used to harden carbon, alloy and stainless steels of all analyses. The process is commonly used with gears, shafts, springs, tools, dies and machine parts.

Salt baths for heat treating carbon and alloy steels (other than high-speed steel) should melt below 1240 F and should be extremely fluid at the working temperature. A salt bath leaves only a thin protecting film on the work and keeps drag-out losses low. Water-soluble salts are preferable, so that the work comes clean and bright from the quench. Heat treating salts should also be non-hygroscopic and non-corrosive to the equipment and the work.

The salts are primarily sodium, potassium and barium chloride, in various proportions. In the low temperature range baths, sodium and potassium chloride predominate. The baths that are used at higher temperatures, above 1700 F, are mainly barium chloride. The salts should be free of sulfides, sulfates, oxides, carbonates and fluorides.

Small amounts of sodium cyanide, silicon carbide or borax, called rectifiers, are sometimes added to prevent decarburization of the parts during heating. Gaseous methyl chloride is also used frequently as a rectifier. The need for rectification may be over-emphasized in many cases. These additions are certainly of much less importance with refractory pots than with metal pots.

Neutral hardening salt baths have a number of advantages over other hardening methods. They give more production in less space, with less labor, since the heating cycles are four times faster than in radiant heated furnaces. Scaling and decarburization are avoided without expensive gas-producing equipment or precise automatic temperature controls. The control of distortion in the work is also outstanding. Salt baths should not be used, however, with parts that cannot be removed from the bath without excessive drag-out of salt.

Typical Salt Bath Solutions

Baths for High-Speed Steels

Preheating: operating range 1250 to 1650 F

1. 45% sodium chloride; 55% potassium chloride
2. 54% sodium chloride; 44% potassium chloride; 2% sodium fluoride
3. 70% barium chloride; 30% potassium chloride
4. 55% barium chloride; 20% sodium chloride; 25% potassium chloride

High heat: operating range 1750 to 2400 F

5. 95% barium chloride (min); 5% silicon dioxide (max)
6. 95% barium chloride; 5% sodium chloride
7. 98% barium chloride; 1% titanium dioxide; 1% silicon dioxide
8. 92% barium chloride; 5% calcium fluoride; 3% silicon dioxide

Quench: Operating range (1000 to 1380 F)

9. 20% sodium cyanide; 40% sodium chloride; 40% sodium carbonate
10. 20% sodium cyanide; 25% potassium chloride; 25% potassium carbonate; 30% sodium carbonate
11. 30% potassium chloride; 55% sodium chloride; 15% sodium cyanide

Tempering: operating range 980 to 1550 F

12. 21% sodium chloride; 31% barium chloride; 48% calcium chloride
13. 15% sodium chloride; 25% potassium chloride; 20% calcium chloride; 40% barium chloride
14. 50% sodium chloride; 20% potassium chloride; 30% barium chloride

Nitriding: operating range 950 to 1100 F

15. 44% sodium cyanide; 32% sodium carbonate; 24% potassium chloride
16. 40% potassium cyanide; 60% sodium cyanide
17. 35% sodium cyanide; 21% sodium carbonate; 17% potassium carbonate; 22% potassium chloride; 5% sodium fluoride
18. 20% sodium carbonate; 15% potassium chloride; 15% sodium chloride; 35% sodium cyanide; 15% potassium carbonate

Neutral Hardening Baths

For alloy carbon and stainless steels—isothermal and other treatments.

19. Same as No. 13 (950 to 1550 F)
20. Same as No. 1 (1250 to 1650 F)
21. Same as No. 2 (1250 to 1650 F)
22. 80% barium chloride; 20% potassium chloride (1250 to 1945 F)
23. 78% barium chloride; 17% calcium chloride; 4.5% sodium fluoride; 0.5% silicon carbide (1250 to 1945 F)
24. 75% barium chloride; 4.5% sodium chloride; 20% calcium chloride; 0.5% silicon carbide (1250 to 1945 F)

Tempering and Isothermal Transformation Baths

25. 3% sodium nitrate; 42% sodium nitrite; 55% potassium nitrate (290 to 1100 F)
26. 5% sodium nitrate; 45% sodium nitrite; 50% potassium nitrate (290 to 1100 F)
27. 15% sodium nitrate; 35% sodium nitrite; 50% potassium nitrate (320 to 1100 F)
28. 20% sodium nitrate; 30% sodium nitrite; 50% potassium nitrate (320 to 1100 F)
29. 55% sodium nitrate; 45% potassium nitrate (475 to 1100 F)

Nonferrous Annealing Baths

30. 50% sodium carbonate; 25% potassium chloride; 25% sodium chloride (1100 to 1700 F)
31. 45% sodium carbonate; 45% potassium chloride; 10% sodium chloride (1000 to 1500 F)
32. 35% sodium carbonate; 10% sodium fluoride; 30% potassium chloride; 25% sodium chloride (1110 to 1680 F)
33. 95% barium chloride; 3.5% calcium fluoride; 1.5% barium fluoride (1200 to 1965 F)

Carburizing Baths

In order of increasing depth of case—operating range to 1545 to 1700 F

34. 25% sodium cyanide; 45% barium chloride; 10% potassium chloride; 18.5% sodium chloride; 0.5% silicon carbide; 1% carbon
35. 20% sodium cyanide; 30% barium chloride; 30% sodium chloride; 20% sodium carbonate
36. 41% sodium cyanide; 25% sodium carbonate; 25% potassium chloride; 7.5% sodium fluoride; 0.5% silicon carbide; 1% carbon
37. 45% sodium cyanide; 9.5% barium chloride; 10% potassium chloride; 34% sodium chloride; 0.5% silicon carbide; 1% carbon
38. 42% sodium cyanide; 29% sodium chloride; 20% potassium chloride; 7.5% sodium fluoride; 0.5% silicon carbide; 1% carbon
39. 65% sodium cyanide; 8.5% barium chloride; 15% potassium chloride; 10% sodium chloride; 0.5% silicon carbide; 1% carbon
40. 85% sodium cyanide; 8.5% barium chloride; 5% sodium chloride; 0.5% silicon carbide; 1% carbon
41. 88% sodium cyanide; 9% sodium fluoride; 1% silicon carbide; 2% carbon
42. 10% sodium cyanide; 50% barium chloride; 10% potassium chloride; 10% sodium chloride; 20% sodium carbonate

Note: Silicon Carbide must be 80-120 mesh without fines, and graphite may be used in fine flake form.

Bright Tempering and Austempering Quenching Baths

43. 50% sodium hydroxide; 50% potassium hydroxide (500 to 1000 F)
44. 12% sodium cyanide; 24% sodium carbonate; 12% sodium chloride; 8% sodium fluoride; 44% sodium hydroxide (500 to 1000 F)
45. 60% zinc chloride; 19% potassium chloride; 20% sodium chloride; 1% sodium fluoride (525 to 1000 F)

Descaling Baths

46. 98% sodium hydroxide; 2% sodium hydride (700 to 725 F)
47. 50% sodium hydroxide; 50% potassium hydroxide (500 to 1000 F)

Prepared by George N. Vitt, Editor, "American Exporter Industrial"

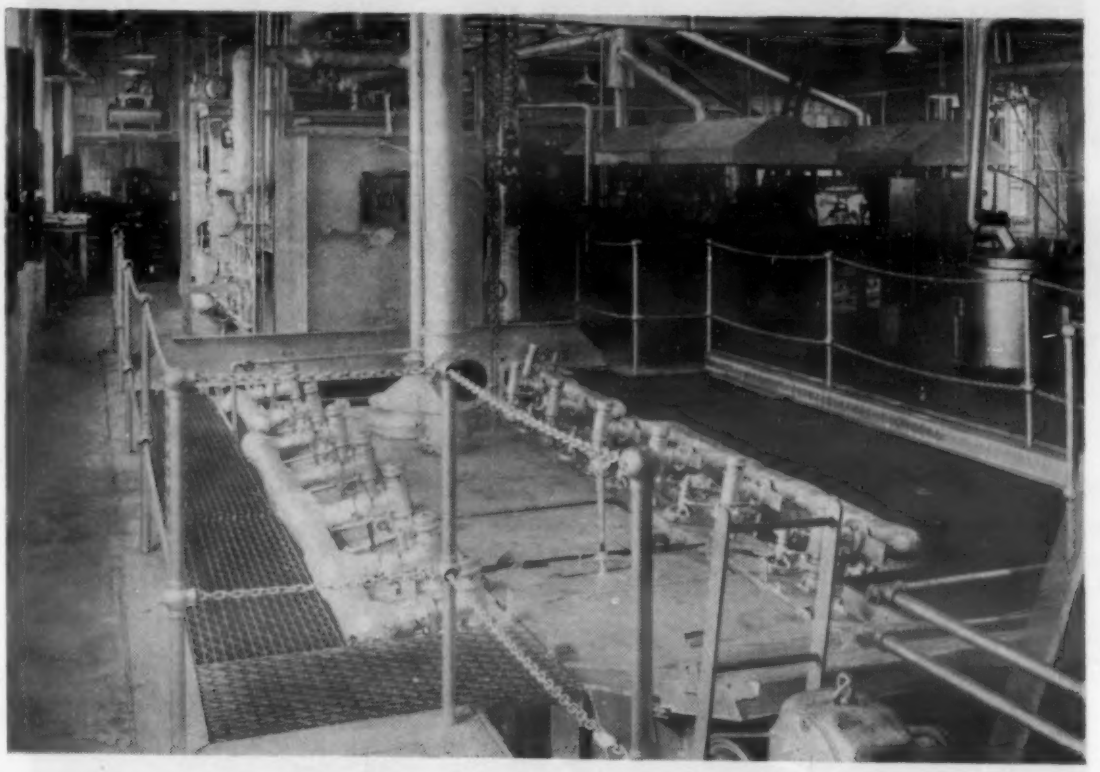
Isothermal Heat Treatments

Time-temperature-transformation data have been developed for many of the standard steels, and these data are being applied to quenching at elevated temperatures. The high fluidity of properly selected salt mixtures and the absence of a vapor layer around the part when hot work is immersed in the bath have led to wide use of fused salts as quenching media. The baths are usually mixtures of nitrates and nitrites with a working range from 350 to 1100 F.

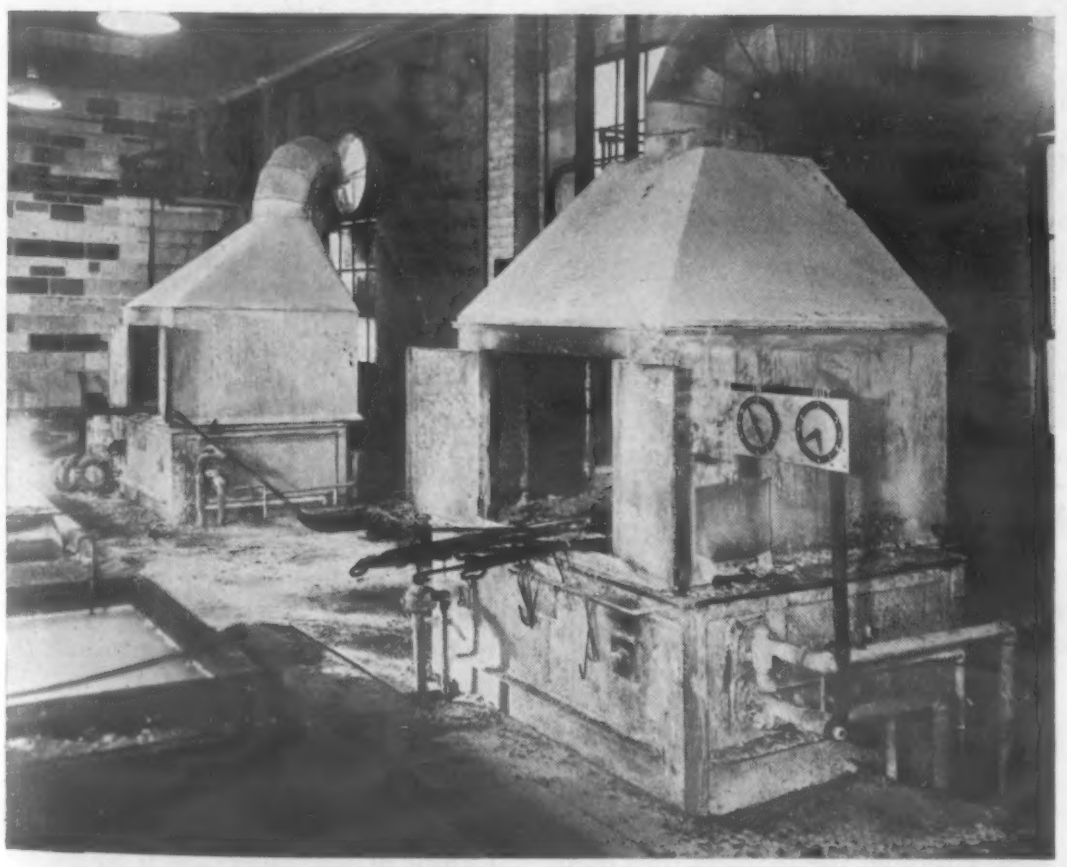
Reduced distortion and the elimination of quench cracks are the principal advantages. The thickness of the section that can be fully hardened by salt bath quenching is limited, of course, and will vary with the steel composition used. The TTT diagram of the steel is helpful in estimating the maximum section that can be quenched successfully. It should be noted that suitably cooled and agitated nitrate-nitrite baths at 400 F have essentially the same cooling power as still oil at room temperature.

The equipment required consists first of a furnace to put the work into an austenitic condition. This is usually a neutral salt bath furnace, although it can be of any other type. Secondly, a salt bath quench furnace must be provided. A third furnace for tempering might be required to give the desired hardness. All three furnaces are generally salt baths. Since the quenching furnace must be a salt bath, and the work must be fixtured correctly for introduction into this bath, handling is simplified if all three units are salt baths so that no refixturing is needed.

The austenitizing bath is an alkali chloride mixture. The quenching bath, and sometimes the tempering bath, are eutectoid nitrate-nitrite mixtures. When the tempering temperature is high enough, however, the tempering bath is straight nitrate salts, which are cheaper than the



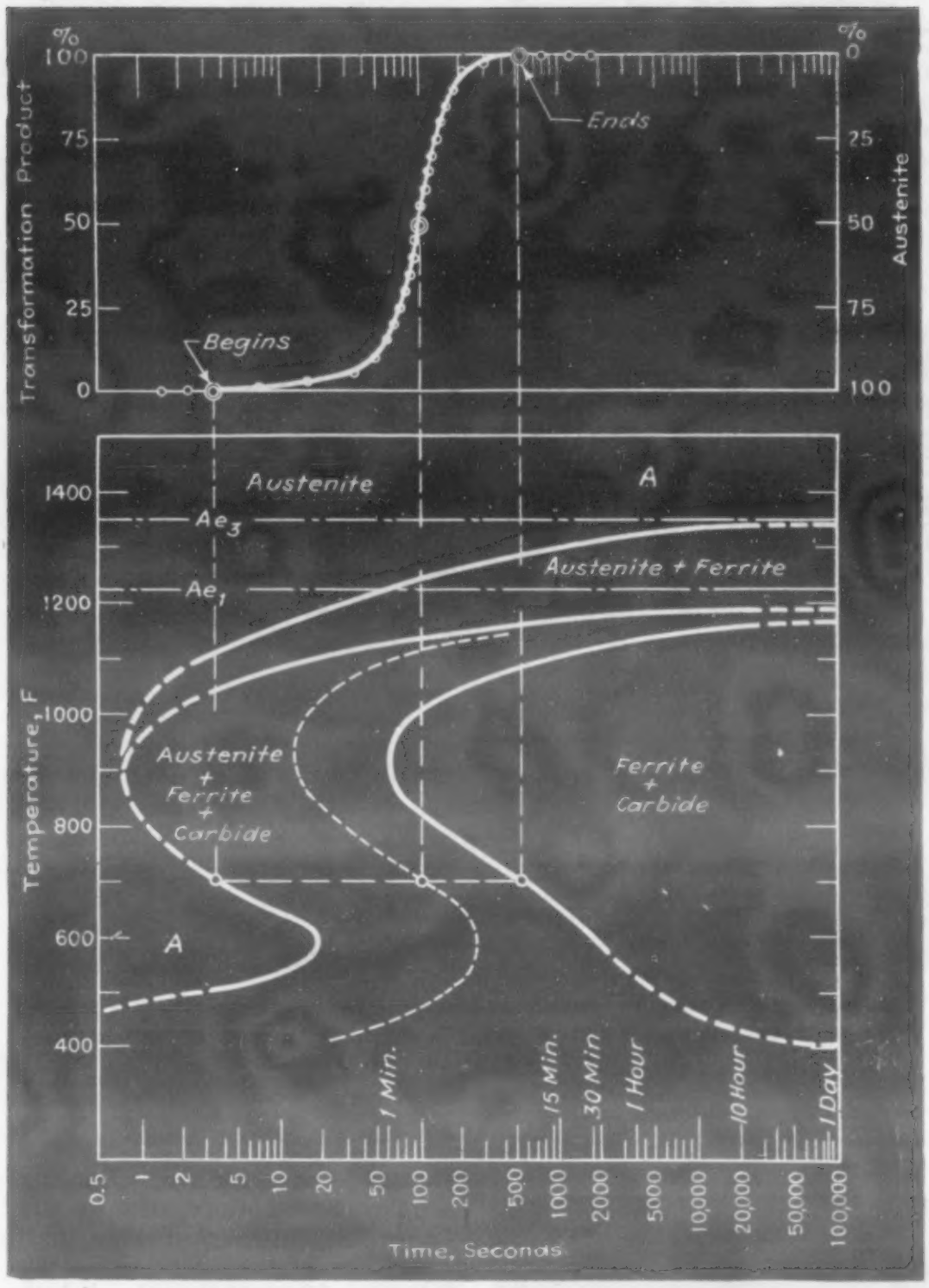
Isothermal heat treatments can combine salt baths with atmosphere furnaces. The salt bath in the foreground austempers parts hardened in the radiant furnace in the background. (Surface Combustion Corp.)



Rectangular fuel-fired pot furnaces are used to harden automotive clutch parts. (Surface Combustion Corp.)

mixture. All fixtures must be thoroughly cleaned after quenching. This is important, since if even small quantities of the nitrate-nitrite salts are carried back to the chloride baths the work will be seriously decarburized and pitted. Another problem is contamination of the quench bath with carry-over chlorides from the austenitizing bath. Excessive contamination reduces the fluidity of the quench bath.

An isothermal quench bath must be designed as a heat extracting and exchanging device. It is not a draw bath converted to isothermal quenching. The exterior of the pot and the air chamber surrounding it extract heat from the quenching bath by circulating a large volume of air. One or more submerged motor-driven pumps propel the fused salt through nozzles against the work to cool heavy sections as rapidly as possible. A salt extracting apparatus is also provided to remove the chloride salts that carry over from the high temperature bath and precipitate out in the quench bath. If these chlo-



Typical isothermal transformation diagram illustrates the mechanism of isothermal heat treatments. The top curve shows the progress of transformation at a constant temperature. (United States Steel Corp.)

rides are not removed, they cake on the pot and may seriously affect the quenching power of the bath.

Austempering—This is a heat treating process in which the transformation of austenite is controlled to yield Bainite, intermediate between martensite and pearlite. Bainite has high strength and high ductility. Alloys with a carbon content approaching the eutectoid value are quenched in a molten salt bath at from 400 to 800 F. The work is held in the quench bath at the appropriate temperature until the transformation is complete. This treatment provides medium hardness, combined with ductility and toughness and good control of distortion.

Austempering is used on relatively light sections (1½ in. or less) where hardness between 35 and 50 Rockwell C and toughness or the ability to bend without breaking is required. Pieces like shoe shanks, typewriter parts, sewing machine parts, automobile bumpers, springs, clutch plates, wrenches and pliers are commonly austempered. Carbon steels of the SAE 1000 series are generally used, although alloys are also austempered occasionally.

The treating cycle and the metallurgy involved in austempering cast iron resemble those employed with steel, although the temperatures used are different. The treatment is claimed to increase the strength and ductility of cast iron.

One modification of austempering employs a direct transfer of work from the quench to a tempering bath. The steel parts are austenitized in the usual way, quenched to a relatively low temperature (400 to 500 F), held in the bath long enough for transformation, and then transferred to a higher temperature (650 to 700 F) tempering bath to give the desired hardness. Larger sections (up to 1¼ in.) can be done than by regular austempering because of the greater quenching power of the cooler bath. This treatment is called modified austempering or 3-Step Treatment. It takes advantage of low temperature quenching for increased rate of cooling, yet the parts are highly tempered. In general, the structure obtained is Bainite.

Martempering—This is a heat treatment in which the steel is fully hardened, but the residual quenching strains, which often cause cracks and distortion, are minimized. The procedure consists of austenitizing the steel, quenching into a molten salt bath held at a temperature just above the martensite transformation zone (400 to 600 F), holding for a sufficient time to equalize the temperature throughout the piece, air cooling to room temperature, and finally tempering in the conventional manner. Martensite is formed uniformly, almost simultaneously, throughout the section during the air cool. Thus, a fully hardened martensite structure is obtained with a minimum of residual strains. Martempering provides high hardness, equal to that obtained with oil quenching, with greatly reduced distortion and practically no cracks or internal stresses in the hardened piece.

Alloy steels and carburized steels are the rule in martempering, and thicker sections (up to 3 in.) can be martempered than can be austempered. In ball bearing races, SAE 52100 is martempered commercially in sections up to 1¼ in. thick. Many tools, gages, gears, shafts, blades, wrenches and accurately finished parts are also treated. The greatest advantage of the process is the control of distortion—final grinding of heat treated parts is expensive and even a moderate reduction in this grinding may easily pay for the heat treating.

One of the most promising applications of martempering is its use on carburized parts. Steel parts, ½ in. thick for carbon steel and up to 3 in.

thick for alloy steel, can be treated to harden the case and toughen the core.

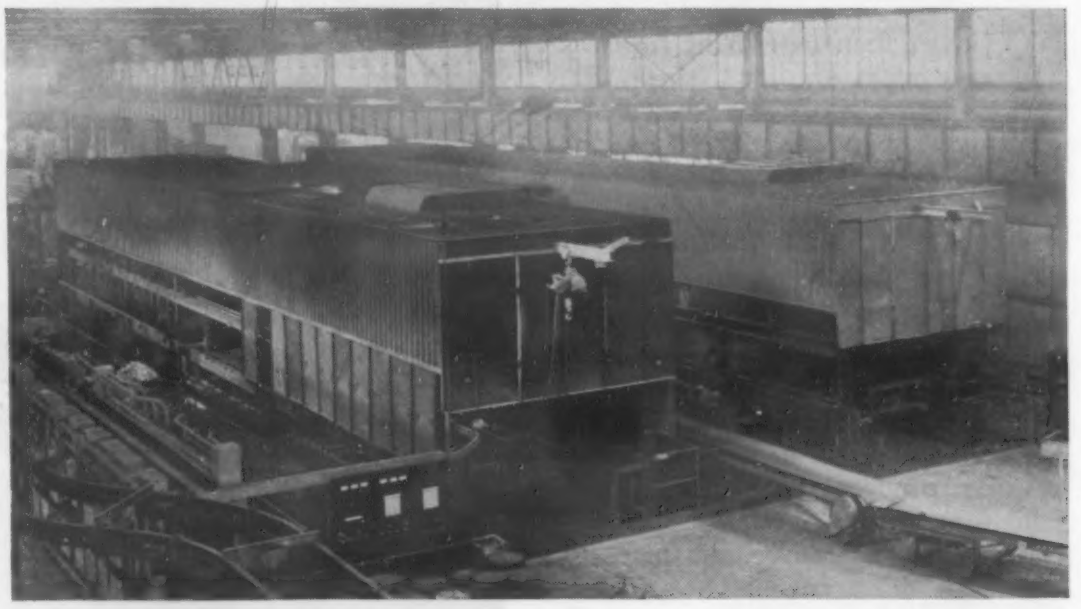
For this process, a molten salt bath washing operation must be set up between the carburizing and the quenching baths. This intermediate bath is usually fused alkali chloride. Some cyanide will be carried into the wash bath, but work can be quenched into molten nitrates from a wash bath containing up to 5% cyanide. With higher concentrations, there will be burning and spitting in the quench, and the cyanide content of the rinse bath should be checked periodically.

To avoid this cyanide contamination, parts can be air cooled from the carburizing bath and water washed. The dried parts are then martempered by reheating in chloride baths to a point above the critical temperature, and quenched. All the fixtures must be thoroughly cleaned after quenching to prevent the addition of nitrates to the cyanide or the reheating baths.

Cyclic annealing—Cyclic annealing in salt baths is a treatment in which the work is heated in a neutral salt to austenitizing temperature, 1500 F or above, then transferred to another neutral bath at 1100 to 1300 F, where it is cooled rapidly to this sub-critical temperature and held there long enough to effect complete transformation. This is a practical means of annealing high-carbon and alloy steels when saving time is important. The salt bath treatment permits better control of the transformation than long-cycle furnace operation and gives more uniform and consistent results, with a minimum of decarburization. The whole cycle requires from 30 min to a few hours, in contrast to the 5 to 24 hr required with the extremely slow cooling rates used in conventional furnace annealing. Cyclic annealing produces a soft, easily controlled structure.

Several forging manufacturers have adopted cyclic annealing, using the residual heat of the forging as it comes from the press or the hammer. The hot forgings, above the upper critical temperature, are quenched in an agitated salt bath at the sub-critical temperature of the particular steel (1150 to 1250 F). The forging transforms quickly to the desired pearlite structure, and is then water quenched to remove the scale. Pickling and blasting are eliminated and the forging is ready for machining 15 min to 1 hr after it leaves the press. Economies are also indicated in machining because of the better grain structure that is obtained.

Austempering is one of the most important commercial salt bath applications. Many austempering baths are completely mechanized for large scale production. (Ajax Electric Co.)



Huge mechanized salt bath furnaces are used to austemper automobile bumpers. (Ajax Electric Co.)

High-Speed Steel Treatments

The hardening of high-speed tools is one of the most exacting operations in industry today. The metal must be heated to near the melting point, 2200 to 2400 F, and a bright, clean surface, with no surface imperfections, must be retained in the finished product. The value of a single day's production may equal the investment represented by a battery of furnaces, so that quality in the product is the first requirement and operating costs are secondary.

Hardening—The majority of quality tool manufacturers now use salt bath furnaces. Any steel—tungsten,

molybdenum or cobalt type—can be hardened merely by changing the temperature setting. Internal stresses in the finished parts are negligible with salt bath quenches.

The procedure used employs four baths: preheat, high heat, quench and draw. The preheat bath operates at 1400 to 1700 F and is a mixture of alkali metal chlorides, with alkaline earth chlorides sometimes added.

The high temperature heating is critical in hardening high-speed steel. The fused salt used must remain fluid at the operating temperature, must be inert to the work, and must wash off the work easily. Barium chloride is used, operating at 2000 to 2400 F. These baths are inert to the steel when freshly melted, but the accumulation of metal oxides tends to make them decarburizing. Deoxidation (rectification) is accomplished in one or both of two ways. Silica can be added to combine with the oxides to form silicate sludge. A slower method, which produces no sludge, is the use of a graphite rod which reduces the oxides to the pure metals. These metals adhere to the rod and can be scraped off periodically.

The hardening temperature depends on the steel being treated. The temperature should be held 25 to 40 F lower than in radiant furnaces for equivalent results, since the charge comes closer to the actual control temperature. The steel is brought just up to the operating temperature and is not soaked.

The quench baths, operating at 1100 to 1300 F, are alkali chloride mixtures, with or without barium chloride. Cyanide-containing chloride baths are preferred by some operators, however, because the work is brighter and because the presence of cyanide produces a file-hard case which is insurance against any decarburization that may take place in the high heat bath. The quench baths should operate below 1200 F. The temperature maintenance is complicated by the fact that the melting point of the salts is raised by carry-over of barium chloride from the high-heat bath. In cyanide-containing baths a crust may form on the surface and the bath must be bailed out frequently and fresh salt added to keep the melting point low enough. After the work has come to temperature in the quench bath, it is cooled slowly in still air to room temperature and washed thoroughly before being put into the tempering bath.

While moderately small pieces can be hardened successfully by quenching in oil or in still air, a molten salt bath quench is recommended. It equalizes the temperature throughout the part before further cooling, and prevents cracking.

Tempering—Tempering temperatures vary from 1000 to 1150 F, depending on the hardness desired. The duration of the tempering cycle depends upon the temperature and the results desired. In general, the time is 1½ to 2 hr for each tempering operation. After tempering, the work is air cooled to room temperature and washed. Tempering salt baths can be nitrate-nitrite mixtures, or sodium chloride, calcium chloride mixtures. If calcium chloride is present, special care should be taken to wash the salt from the work. A short pickle in inhibited mineral acid or 10% acetic acid is necessary to avoid subsequent rusting.

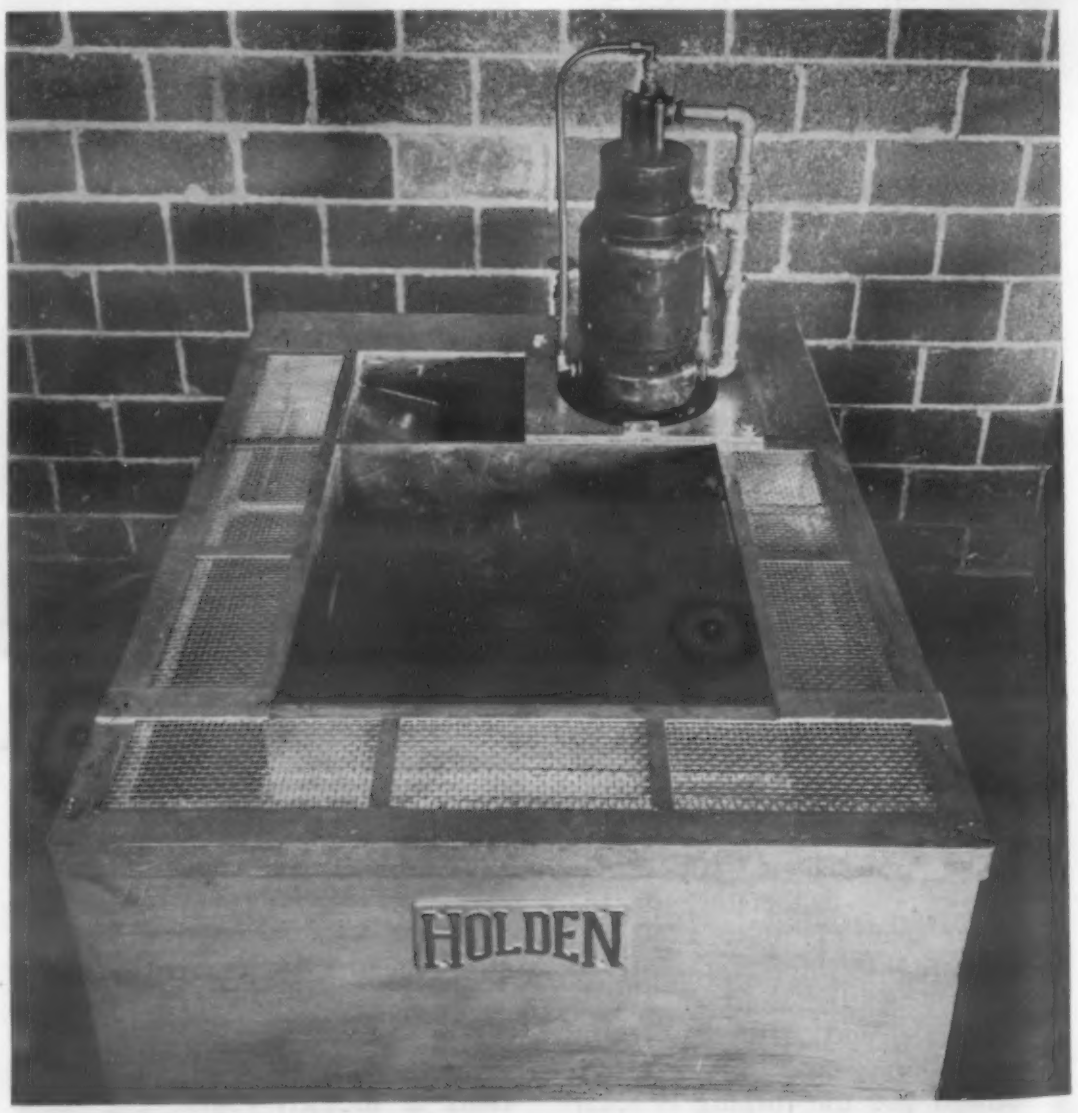
Many operators prefer multiple tempering, which usually gives better physical properties. In this multiple tempering, it is essential that the tools be cooled slowly to room temperature after each heating period.

Nitriding—Occasionally the tools are nitrided, which is always done in a salt bath and requires another furnace unit. This process is described above under Case Hardening Salt Baths. Part of the multiple tempering cycle can be carried out in a cyanide nitriding bath, but all the nitrate tempering salts must be washed thoroughly from the work before immersion in the nitriding bath.

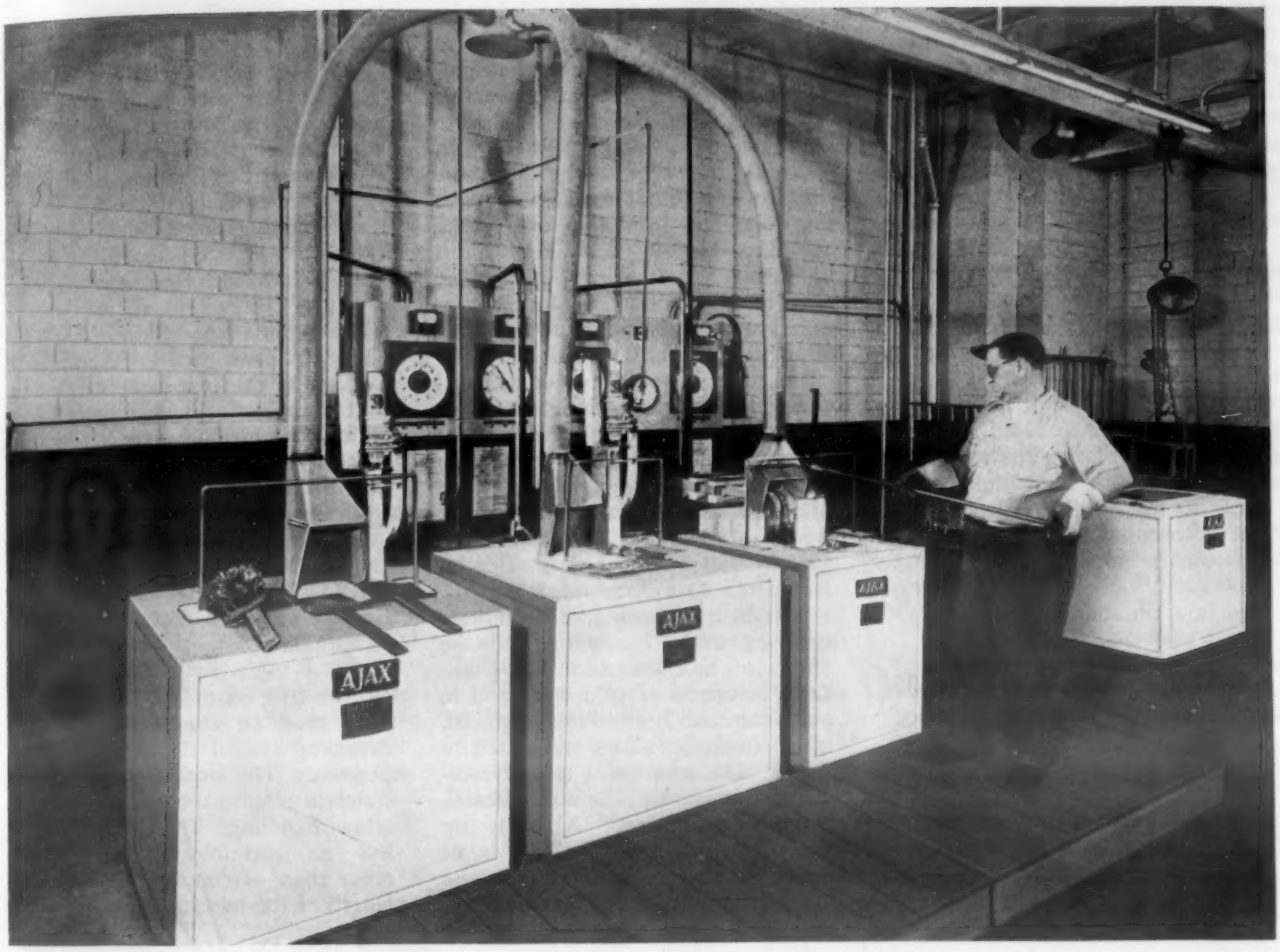
Annealing

Salt bath annealing is growing in popularity because of the rapid rate of heating and because of the protection given to the metal surface. The principal application is stress relieving or process annealing, in which the metal is softened after cold work for further forming or finishing.

The time-temperature cycle used depends upon the alloy treated, the amount of cold work it has been subjected to, and the amount of softening desired. The carbon and engi-



A typical austempering-martempering furnace has a motor mounted directly to the pump, which circulates 40 to 50 gal per min of fused salt. (A. F. Holden Co.)



High-speed steel tools of all analysis are hardened in the temperature range from 2200 to 2400 F. In this installation the bath fumes are handled safely in small ventilating pipes. (Ajax Electric Co.)

neering alloy steels are heated to a point just below the transformation range and the work is removed from the bath as soon as it has reached temperature. Batches of this type of work are annealed in less than 1 hr. Temperatures range from 1250 to 1325 F. The intermediate grades of stainless steel are treated at the same temperatures, but are usually held at temperature up to 30 min. The austenitic stainless steels and certain nickel alloys are process annealed from 1850 to 2100 F. The temperatures and time periods used with nonferrous metals depend on the metal composition, the amount of cold work, and the subsequent operations, but about the same speeds hold as with ferrous material.

The carbon and engineering alloy steels are usually annealed in sodium carbonate, potassium chloride baths. The same baths can be used for the intermediate grades of stainless. A barium chloride bath is widely used to anneal the austenitic stainless steels and nickel alloys, while a low-temperature carbonate-chloride mixture is usually used for nonferrous alloys.

In the wire industry, salt bath annealing is used for carbon, alloy and stainless steels between passes, and for heating austenitic stainless for the final softening quench. Salt baths are also used to anneal sterling silver for further forming, to anneal aluminum wire and shapes, and to stress relieve cupro-nickel tubing, copper-chromium bars and shapes, and other copper alloy parts. The main disadvantages of salt bath annealing are the necessity for a rinse to remove the salt, and the need for a continuous flow of material to ensure economical operation.

Tempering and Coloring

Many carbon and alloy steel parts require tempering to remove the quench stresses and to increase ductility and toughness by lowering the hardness to the required degree. This tempering can be done in nitrate salt mixtures at temperatures ranging from 350 to 1150 F. Some tempering is also done above 1100 F in fused mixtures of alkali and alkaline earth chlorides. The finished colors vary from light straw, obtained in baths at 450 F, to gun metal, obtained at 625 F. These figures apply to 0.50% carbon steel; higher temperatures are required to get the same results with lower carbon steels.

Nitrate baths with manganese dioxide additions can also be used to color steel parts. These baths operate at from 450 to 1000 F and impart a characteristic blue color to prefinished surfaces. The time of immersion varies with the temperature and the size of the work, but rarely exceeds 6 min. The same furnace unit is often used for both tempering and coloring. The metal must not be left in the bath longer than is necessary to produce a blue color, however, since overexposure turns the surface

black.

A dense iron oxide black finish can be produced in baths of molten nitrates and sodium hydroxide. This finish has relatively poor resistance to corrosion but provides an excellent base for oils and waxes. The color developed is denser than with caustic-free baths, since the sodium hydroxide etches the surface and yields a heavier oxide film. This etching becomes severe at 825 F, however, and the usual operating range is 600 to 825 F, depending on the steel.

An attractive, rust-proof finish can also be produced in fused salt baths by chromium plating the metal part and then treating it in molten cyanide. This black finish is as rust-resistant as chromium plate itself, but the degree of protection depends on the thickness of the plate and the care used in application.

Heat Treatment of Aluminum and Beryllium-Copper

Certain aluminum and beryllium-copper alloys are heat treated in salt baths to obtain improved physical properties. Salt baths have a number of advantages in treating these metals. They give a high degree of temperature uniformity, which is essential, and the rapidity with which the work comes to temperature minimizes diffusion between the layers of clad alloys. Salt baths are used more with wrought products than with castings, however, since irregular shapes and rough surfaces increase the drag-out loss and may make cleaning difficult. Residual salt can cause severe corrosion.

Treating aluminum involves a solution heat treatment at a temperature high enough to ensure solution of the hardening constituents, followed by rapid quenching, and then aging or precipitation hardening at relatively low temperatures. The time at temperature depends upon the alloy used and its gage. Most of the wrought alloys are treated at from 880 to 980 F, and the time cycles vary from 10 min to 1 hr.

Salt bath annealing of aluminum removes strain hardening and the effects of heat treatment. To eliminate the effects of cold work and to partial anneal heat treated material, most aluminum alloys are heated to 660 F. The subsequent rate of cooling is unimportant. For a full anneal, most alloys (except XB75S) are treated at 750 to 800 F for 1 hr or more, then cooled to 500 F at a rate not greater than 50 F per hr. Below 500 F, the cooling rate is not important.

The salt generally used for heat treatment of aluminum is sodium nitrate. If the bath is used for both heat treatment and annealing, however, a mixture of sodium and potassium nitrates is used because of its lower melting point. Small amounts of sodium or potassium dichromates inhibit corrosion from the residual salt.

Magnesium-base alloys should never be heat treated in fused nitrate salts, since the two make a combustible combination. Aluminum alloys which contain more than a few percent of magnesium are also not recommended for this type of heat treatment.

Precipitation of beryllium-copper is done between 600 and 700 F in fused nitrate-nitrite mixtures. The time period used depends upon the temperature, ranging from 1 to 3 hr at 600 F to as low as 15 min at 700 F. The temperature and time of the bath must be controlled carefully, becoming critical at the higher temperatures. The work is quenched in water to remove the salt residue and allow handling. The water quench has no metallurgical significance other than to control definitely the length of the heating cycle.

Case Hardening in Salt Baths

A number of salt bath processes are available for case hardening steel. While these processes are classified under generic headings, such a division is actually theoretical. In actual practice case hardening is a combination of the theoretical chemical reactions.

Sodium cyanide is the active salt in most case hardening baths. It decomposes in the presence of air to form sodium cyanate. The sodium cyanate, in turn, decomposes at bath operating temperatures to give carbon monoxide and active nitrogen. The nitrogen and the carbon monoxide are the hardening agents. Nitrogen combines with the steel directly; carbon monoxide is probably converted to active carbon, which then combines with the steel. Carbon increases the hardness of low and medium carbon steel on quenching. Nitrogen, on the other hand, hardens steel directly, without quenching.

The extent that each of these reactions progresses is determined by bath conditions. If the access of air to the solution is interfered with, the rate of cyanate formation is reduced. The higher the temperature, the more rapidly the cyanate is formed. As the temperature rises, more carbon is put into the case, and less nitrogen, as a general rule. Accelerators and catalysts also accentuate the carbon absorption. A high nitrogen content in the case, however, seems to repress the absorption of carbon. Another rule is that the carbon content of the case and the depth of carbon penetration increase steadily with the time the work is left in the bath. The nitrogen, on the other hand, reaches depth and content maximums comparatively quickly, and a prolonged soak in the bath has little further effect.

Most case hardening is done on plain carbon and low carbon alloy steels. In all these steels, the grain size and grain normality affect the process strongly. Although fine-grained steels are easy to through heat treat, they are difficult to case harden. The fine-grained steels can be given a higher carbon case, however, with a narrower graduation zone. It is also true that the greater hardenability of the coarse grained steels is offset by the greater toughness and distortion resistance of the fine-grained types. With grain size, excessive grain abnormality may make it difficult to get uniform hardening.

Alloying elements also affect carburizing. When the added elements lower the upper critical temperature of the steel (*i.e.*, increase the temperature range of stable austenite), the temperature range for efficient case hardening is lowered. If the temperature range for stable austenite is reduced, the range for case hard-

ening increases. These rules sometimes can be reversed by the influence of grain size, however.

Carburizing

Liquid carburizing impregnates steel with carbon and a little nitrogen to increase the surface hardness and resistance to wear. A water, brine or oil quench is used after carburization. Salt bath carburizing gives a case that is similar in carbon content and depth to a gas or pack carburized case. It is one of the most important salt bath uses, and one that is steadily growing.

Carburizing baths contain sodium cyanide salt, with various amounts of alkali and alkaline earth chlorides or special water-soluble compound catalysts to increase the rate at which carbon is absorbed into the steel. The baths operate at 1550 to 1800 F. Below 1550 too much nitrogen is absorbed and carbon pickup is retarded. At 1750 or 1800 F the carbon penetration is rapid but difficulty may be encountered with metal pot maintenance. There is also the possibility of metallurgical changes in the core of the work above 1750 F.

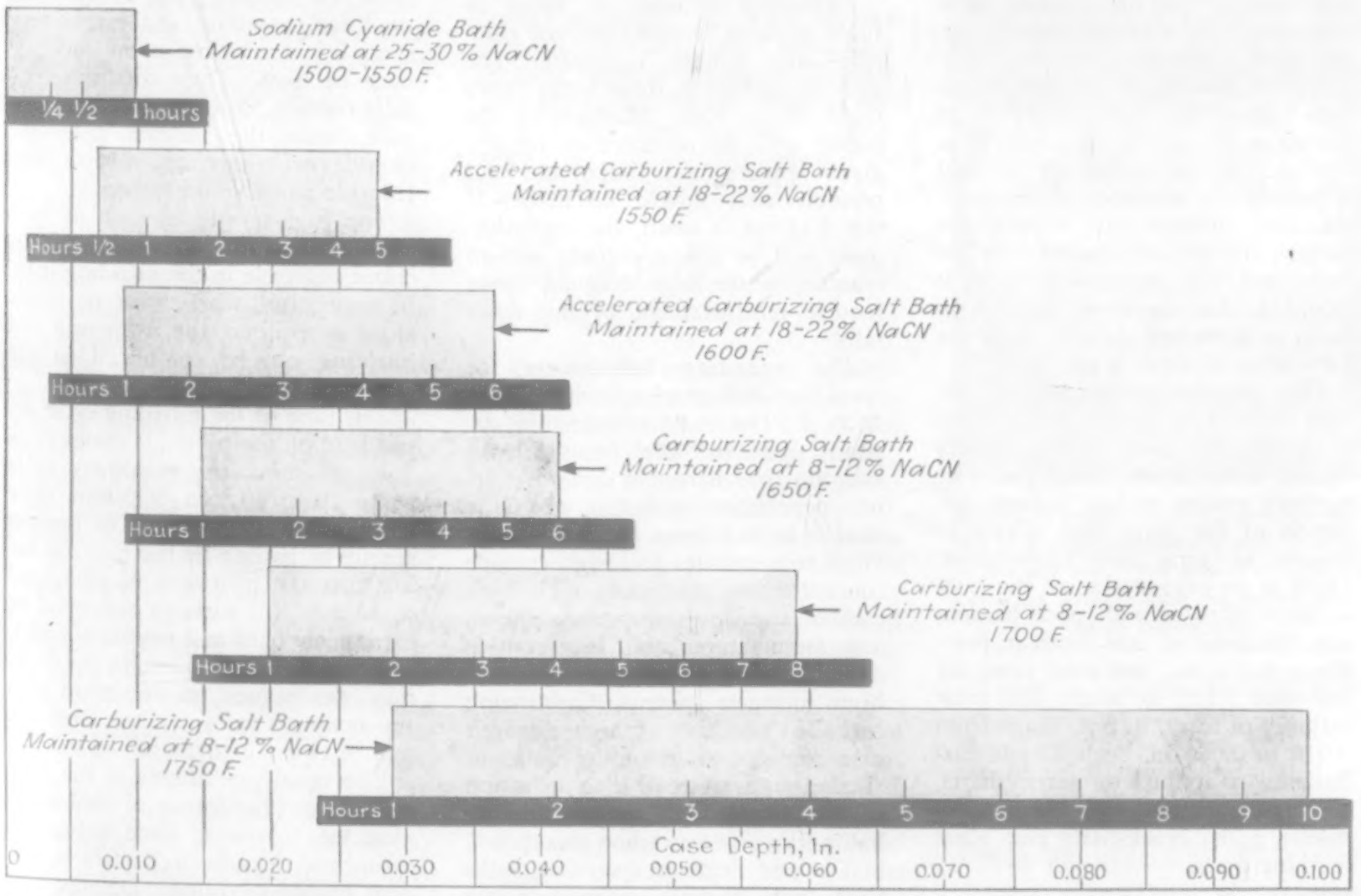
Carburizing baths operating between 1550 and 1650 F contain accelerators which promote carbon absorption. Under normal conditions a concentration of 18 to 22% cyanide is recommended, with a maximum cyanate content of 1.0%. These baths are used to produce cases up to 0.035 in. deep.

Deep cases (0.035 to 0.250 in.) are produced in baths operating at 1650 to 1800 F. These baths contain two catalysts and have a much higher catalyst concentration than the 1550 to 1650 F baths. The higher catalyst content permits full bath activity with a lower cyanide concentration (about 10%), which makes the bath more stable and makes efficient operation at 1650 to 1800 F possible. The cyanate concentration is kept below 0.3%, and the nitrogen content of the case decreases as the bath temperature is raised.

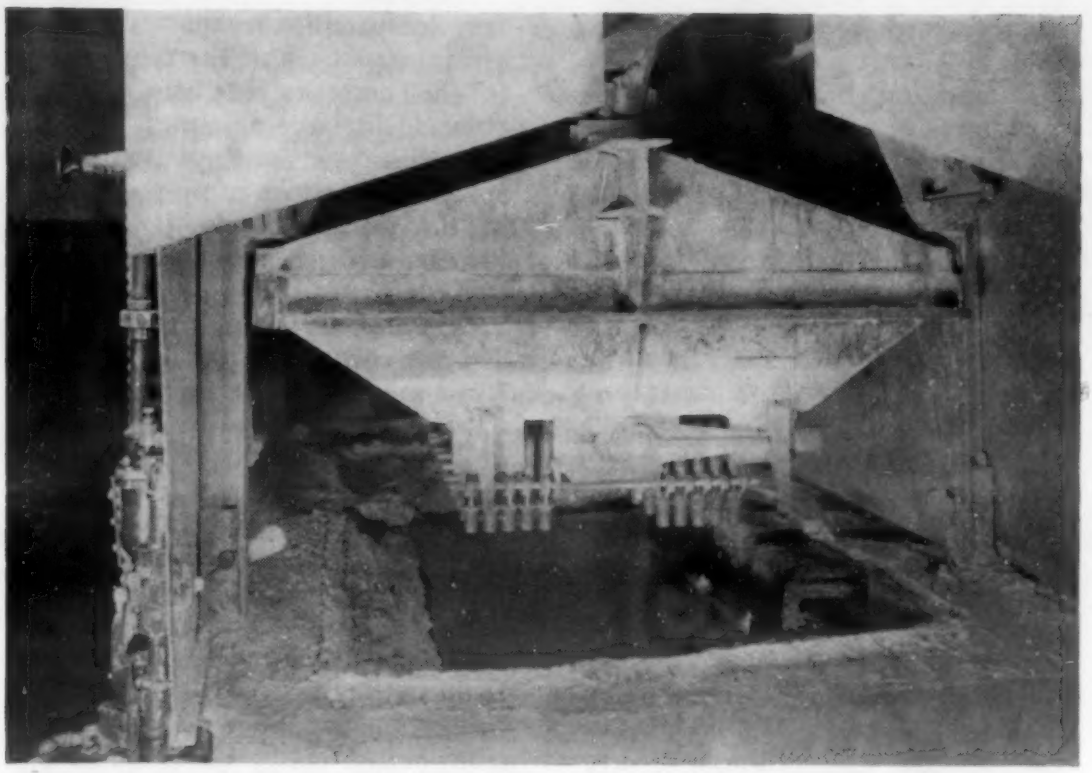
Calcium cyanide is used in some carburizing baths. This salt gives good results for case depths of 0.030 in. or less. One advantage is that much less calcium cyanide is required for comparable results. The most serious drawback of the calcium bath is the necessity of using calcium chloride in large amounts. This salt is hygroscopic enough to require special precautions to prevent rusting of the finished work. It may also increase furnace maintenance costs.

Carburizing baths do not require a high cyanate concentration, and a carbonaceous layer on top of the fused salt is advantageous. This layer may form spontaneously, or additions of flake graphite may be used. The cover reduces heating costs, gives greater pot life, and improves the efficiency in the bath. Excessive scum can interfere with oil quenching, however, leaving soft spots on the work. This trouble can be avoided by limiting the thickness of the cover and by moving the work to break the scum before taking the work out of the bath.

There are other operating features to be noted. The thick sludge that forms in carburizing baths should be scraped out periodically. While little difficulty is experienced in cleaning work from water or brine quenches, an acid pickle is recommended after



The shaded areas show the average case depths to 30% carbon produced on standard carburizing steels at the indicated treating times and temperatures. Shallow cases are put on in a short time by cyanide baths. A carburizing bath treatment is usually longer, and the case obtained much deeper. (E. I. du Pont de Nemours & Co., Inc.)



Shafts are carburized in this immersed electrode bath. The fixture lowers the shafts 1 1/16 in. into the bath for treatment, then carries the work to a water tank for quenching. (Dempsey Industrial Furnace Corp.)

an oil quench when a particularly bright surface is required. Steel parts can be selectively hardened—*i.e.*, some areas can be left without a case—by covering the areas not to be hardened with a dense cyanide copper plate.

Basket loading is common in salt bath carburizing. Several batches of work can be carburized to different case depths simultaneously without impairing the efficiency of the process. For different case depths, the various charges are loaded into the bath and the processing time is recorded for each charge. Each batch is quenched directly from the bath when its time is up.

One of the advantages of salt bath carburizing is the uniform case it produces, even with densely loaded work. Also, the liquid carburizing process is fast, reduces distortion of the parts, and is easy to control in time and temperature. There is no oxygenation of the case, as there often is with pack hardening. The limit of case depth in practice is 0.250 in., and most cases are less than 0.125 in. deep. The great majority of cases, in fact, range from 0.010 to 0.060 in. deep. Liquid carburizing is applied to gears, shafts, bearings, pins, bushings, chain, automotive parts, crankshafts and other machine parts.

Cyanide Hardening

Cyaniding imparts a shallow, file-hard case on steel in a relatively short time. The cyanide bath supplies nitrogen as well as carbon to the case to increase its wear resistance after quenching.

Cyaniding is done in baths of fused sodium cyanide, sodium chloride and sodium carbonate. The cyanide content in these baths varies from 20 to 40%. Maintaining the correct cyanide concentration for any given application is important, and periodic tests should be made. If the drag-out is small, the replenishment will be almost entirely sodium cyanide, while large drag-out losses require reinforcement of the other salts.

The operating temperature for cyaniding baths varies from 1380 to 1625 F. The exact temperature depends upon the steel being treated and the core hardness desired. Carbon penetration is fastest when the steel is heated above the same point. High temperatures and high cyanide concentrations give cases with high carbon and low nitrogen content; low temperatures and low cyanide concentrations give low carbon and high nitrogen content. Carburizing baths do not give as high nitrogen case contents as cyaniding baths at similar temperatures due to the action of the catalysts in the carburizing baths which favor carbon absorption.

The case depth in cyaniding baths does not increase proportionately with time, and cycles longer than 1 hr are not economical. Standard treatment times can be as short as 5 min. The maximum case depth is usually 0.008 in.

Batch type furnaces are generally used, since they give a large production from a small furnace, due to the fast heating rate and the short soaking cycles needed for these shallow cases. Many large mechanized units are used in the mass production industries, however.

In general, cyaniding gives a shallow, cheap, wear resisting surface of high quality. It is used on screws, grease fittings, business machine parts, shafts and bolts. It is also employed to harden heavy duty, quality gears in the automotive field, where high surface hardness is required. Cyanide baths are also used to reheat carburized work.

Nitriding

When high-speed steel and certain other high alloy tool steels are treated in molten cyanide baths at 1000 to 1050 F, they acquire an extremely hard nitride case which improves the life of keen-edged tools. This treatment may make small tools brittle, however, and it is not recommended for tools that are subject to impact.

Since the nitriding temperature is blow the melting point of the baths used for cyaniding and carburizing, special low melting point mixtures must be used. These mixtures typically contain 55 to 60% sodium cyanide, with the balance potassium cyanide or a mixture of potassium chloride and sodium carbonate.

For high-speed steels, it is possible to perform a portion of the tempering cycle in the nitriding bath. In some cases, where wear resistance alone is required, the tempering and nitriding can be completed in the same operation.

The time of the nitriding cycle depends upon the parts. It varies from 5 to 90 min., the customary cycle being 20 to 30 min., a 5-min. cycle modifies the tool enough to prevent seizure or galling by the material being cut; the treatment is prolonged to 30 min. for surfaces that must be extremely hard and require supporting depth. Longer periods, up to 90 min., can be used for maximum wear resistance. Cycles longer than 90 min. may pit or damage the surface.

The usual precautions in the high temperature hardening of tool steels must be followed, since either decarburized or carburized surfaces prevent proper nitriding. Decarburized surfaces may give a brittle case, while carburized surfaces may fail to nitride at all.

Salt Baths for Heat Processing and Cleaning

Another type of salt bath application involves heating work for various industrial process without significant change in the metallurgical properties of the metal. These new applications include production brazing, heating for forging and extrusion, and cleaning operations. Some work has been done on aluminizing steel in salt baths.

Brazing

Brazing is accomplished by dipping the assembly into a salt bath maintained at a temperature somewhat above the melting point of the brazing alloy which has been applied to the joints. As soon as metal at the joints has reached the bath temperature the assembly is removed and cooled. A protective film of salt prevents scaling or decarburization. Salt bath brazing should be used only for parts that can be washed afterwards, because of this salt film. The process is satisfactory with almost any bonding agent—silver solder, bronze, brass or copper. In general, the same fixturing and assembly procedures are used as in furnace brazing.

Copper brazing of steel is usually done at 2050 F in fused barium chloride. The assembly should be quenched in a fused chloride bath at 1000 to 1150 F after brazing. The same bath can also be used for preheating. By selecting the right transformation temperature and time in the quench, it is possible to anneal the steel to the desired pearlitic structure simultaneously. A similar process is used with other brazing metals, except that the temperatures vary with the metal used. For brazing at lower temperatures, alkali metal chloride baths are used.

Brazing baths can also be combined with steel carburizing baths. A carburizing salt is an excellent brazing salt and it is only necessary to select a bonding metal that melts at the correct temperature. Activated carburizing baths are used at about 1675 F, usually using Muntz metal (60 copper, 40% zinc) as the brazing material. The work is quenched in the normal way after carburizing and the brazed joints are obtained at no added cost. Spiral gears and shafts for a conventional motor starter are being manufactured by this combination process.

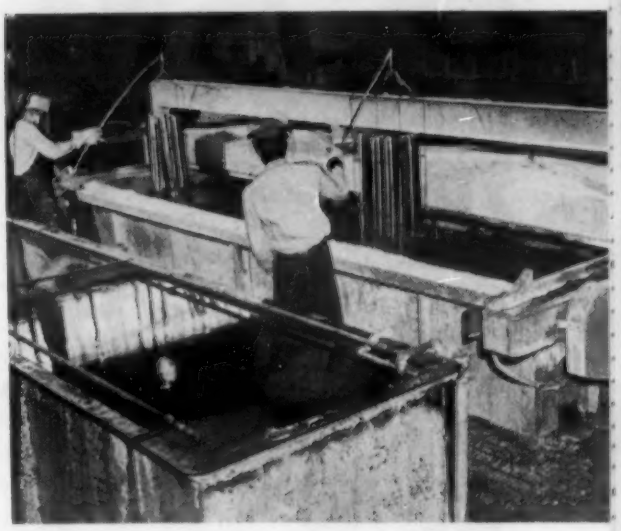
Aluminum parts can be brazed with similar techniques. The process is particularly adapted to thin gage assemblies which permit complete drainage of the molten flux after brazing. The salt bath itself is the flux in this operation. The bath is actually of the same composition as the flux normally used in torch or furnace brazing on aluminum. Parts should be designed so that alignment can be held by the fit of the pieces rather than by fixtures, which increase the drag-out losses. The temperature must be held within 5 deg of the brazing temperature, which varies with the brazing material from 1060 to 1185 F.

Salt bath brazing is in itself, strictly a production process. It is not well adapted to small scale intermediate brazing schedules. Aside from the combination processes, salt bath brazing has been applied where joints at one end of an assembly must be brazed without heating the whole assembly. The joints on the return bends of a heat exchange unit are typical examples. Salt bath brazing is much faster than other methods—in some installations the whole cycle does not exceed 90 sec. It takes less floor space than furnace brazing, since no cooling chambers are needed.

Heating for Forging, Forming and Extruding

One of the most recent applications of salt bath furnaces is for heating bar stock and shapes for forging and forming, and heating alloy steel billets for forging, extruding and other mill operations. These heating operations are done in barium chloride baths at 1600 to 2300 F.

Salt bath heating has a number of advantages for these applications. There is no scaling, pitting or decarburization, since the steel surface is protected at all times. Subsequent grinding and finishing operations are greatly reduced or even eliminated. Since scaling is eliminated, the life of forging and extruding dies is increased considerably. The heating rate is very rapid, offering splendid control of grain growth. A number of pieces can also be heated at the same time. The salt bath is ideally adapted to selective heating, where only part of the piece is to be shaped; a sharp line of demarcation can be held between the heated section and the rest of the part.

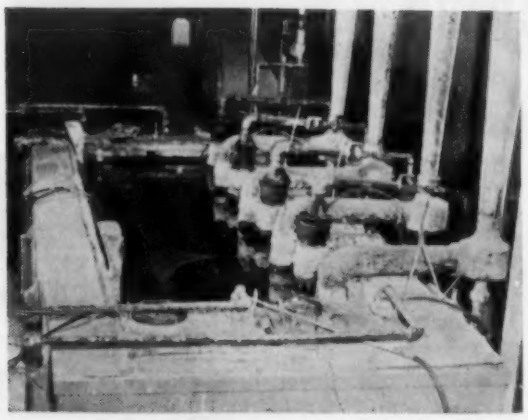


Large batches of aluminum alloy tubes are uniformly heated to 920 F. The salt bath holds the temperature variation from the inside to the outside of the charge to 5 F max. (Ajax Electric Co.)

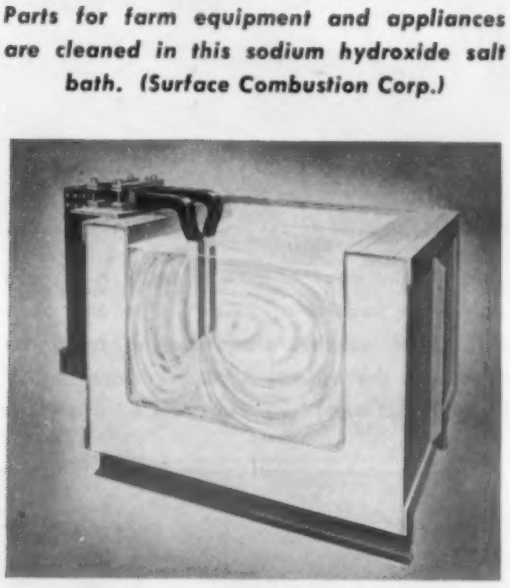
Brazing 44 copper tubes to a radiator manifold in a single operation is done in 3 min in this salt bath. The brazed silver solder joints are stronger than the parent metal. (Ajax Electric Co.)

Descaling, Desanding and Cleaning

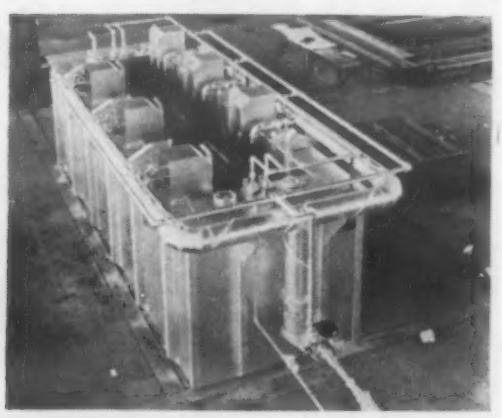
There are a number of applications of salt baths for cleaning metal. Descaling is done in fused sodium hydroxide baths which operate at 700



Parts for farm equipment and appliances are cleaned in this sodium hydroxide salt bath. (Surface Combustion Corp.)



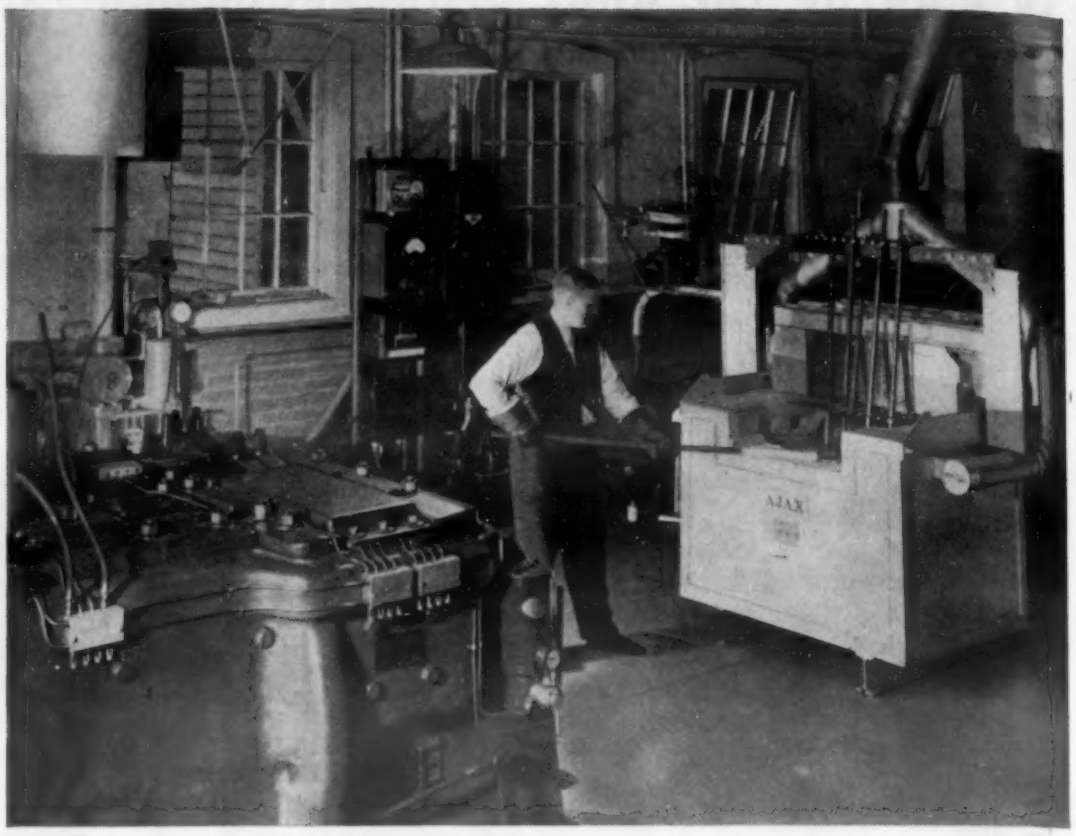
One type of immersed electrode electric salt bath furnace uses electrodynamic forces generated between two closely-spaced electrodes to circulate the fused salt. (Ajax Electric Co.)



This immersion tube gas-fired furnace carries a sodium hydride bath to clean aircraft gas turbine engine parts. (Surface Combustion Corp.)

to 1200 F with suitable chemical additions. The process has been applied commercially to descaling stainless steels, carbon and alloy steels, high-speed tool steels and nonferrous metals like nickel and copper alloys, in sheet and plate form as well as in cast and forged parts.

In one process, the active agent is sodium hydride which reduces the scale so that it can be removed by acid in a matter of minutes. There is no attack on the metal. When the



The salt bath selectively heats the ends of alloy steel bars for upset forging. A sharp line of demarcation is held between the heated and the unheated portions of the bar. (Ajax Electric Co.)

reducing action stops, there is no further reaction in the salt bath. The work is then washed and given a short acid dip. The metal loss is greatly reduced by this process. On stainless steel, for instance, a weight loss of 1½ to 4% is common when strong acids alone are used for cleaning. With a descaling salt bath, the weight loss is kept well below ½%.

Another process for descaling stainless steel uses a sodium hydroxide bath with an added oxidizing agent. The bath operates at 950 to 1200 F. The scale is modified by the oxidizing action of the salts so that it is removed easily by a subsequent water quench and flash pickle.

Descaling can also be combined with a simultaneous tempering operation. The work is immersed in the descaling bath at the desired tempering temperature and left there for the necessary time.

Desanding is similar to descaling, except that silicon dioxide instead of metal oxides are removed. It is used on castings where it is essential that all traces of sand be removed. Outstanding examples are castings used in refrigerator compressors, fuel pumps, hydraulic transmission castings and bearing cups.

Oxidizing salt baths containing larger percentages of nitrates, operating at 800 F, are also being used to clean carbon, grease, rubber and other organic materials off molds and metal parts. These baths clean molds used in the mechanical rubber goods industry. Similar baths clean automobile engine blocks and parts prior to rebuilding. Paint is also being stripped from steel stampings in large mechanized furnaces.

Aluminizing

A special adaptation of the salt bath has been introduced recently to aluminize steel products on a commercial basis. This bath operates in the temperature range of 1350 to 1550 F. The salt composition has not been made public.

The steel to be aluminized is first cleaned thoroughly. It is then put directly into the salt bath. The heating time is rarely more than 3 min. In the bath, the surface of the work is fluxed by special chemical reagents so that the molten aluminum will alloy quickly with the steel to form an aluminum-iron alloy bond.

Two types of aluminizing salt baths are being used. In one design, a 1-in. deep pool of aluminum floats on top of the salt bath. The work goes through the aluminum into the bath and stays there until it reaches bath temperature. It is then withdrawn through the aluminum float. Aluminizing takes place in a few seconds. In the other bath design, the aluminum pool is below the salt. The work goes through the same sequence of operations. In both processes, the steel is water quenched to remove salt traces and assure a bright finish.

Salt Bath Equipment

There are several distinct types of salt bath furnaces on the market. The main differences lie in the materials used for the pots which hold the fused salts and in the methods used to heat the salts. The furnace that should be used in any given application depends upon (1) the salts that are to be used, (2) the temperature at which the bath is to be run, (3) the production rate desired, (4) the continuity of operation, and (5) the furnace life expected. There is no general agreement among furnace manufacturers or users as to just where the line should be drawn between the furnace types on any one of these points.

Many metallurgists were unduly prejudiced against salt bath treatment years ago by unfortunate experiences that were caused by bad furnace design, rather than by any inherent shortcomings in salt bath heat treating. These early furnaces were handicapped by excessive maintenance costs, short pot life, bath size and shape limitations, and poor control of bath chemistry. All of these defects have been largely eliminated in modern salt bath furnace designs.

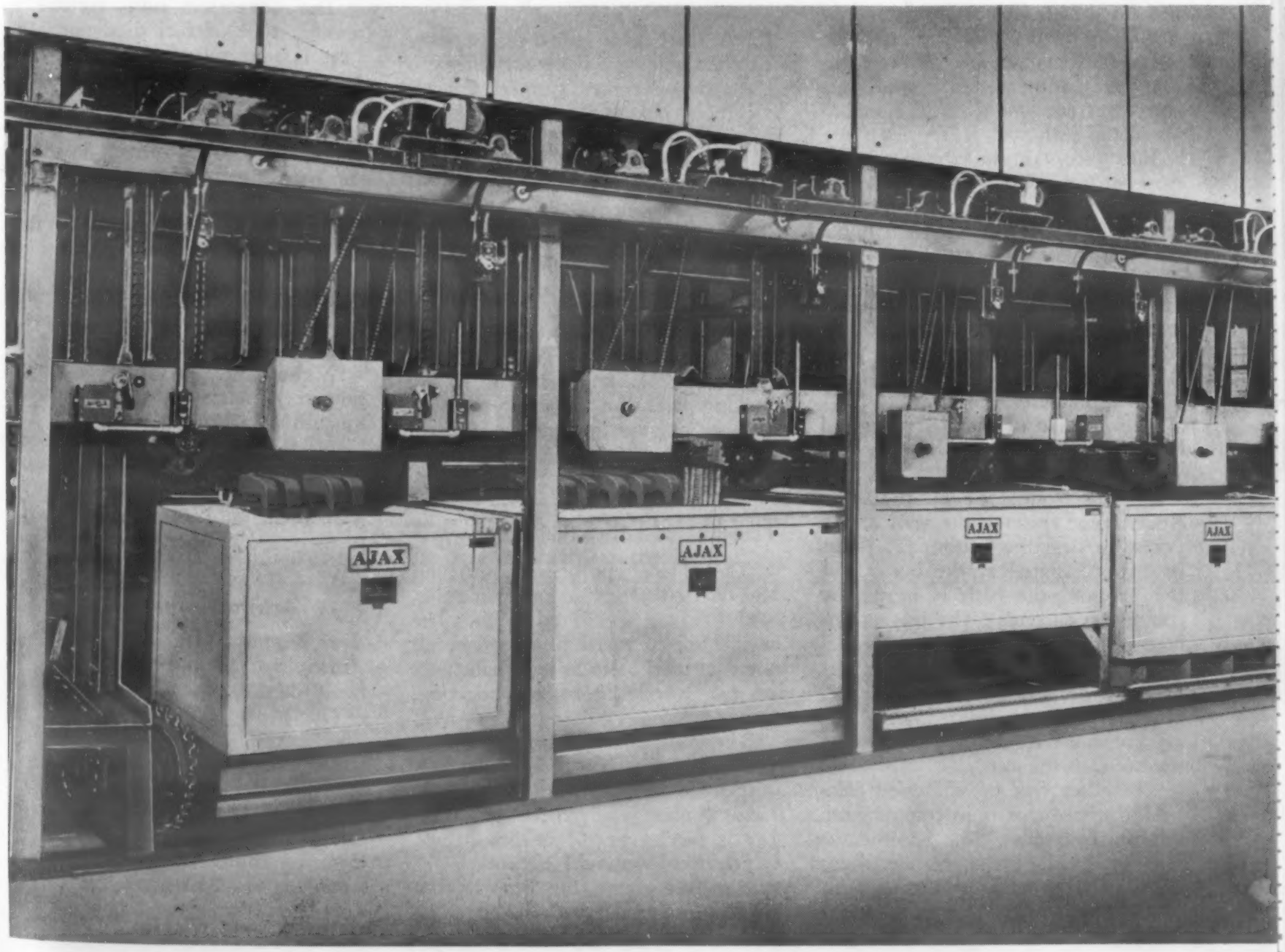
Electric Salt Baths

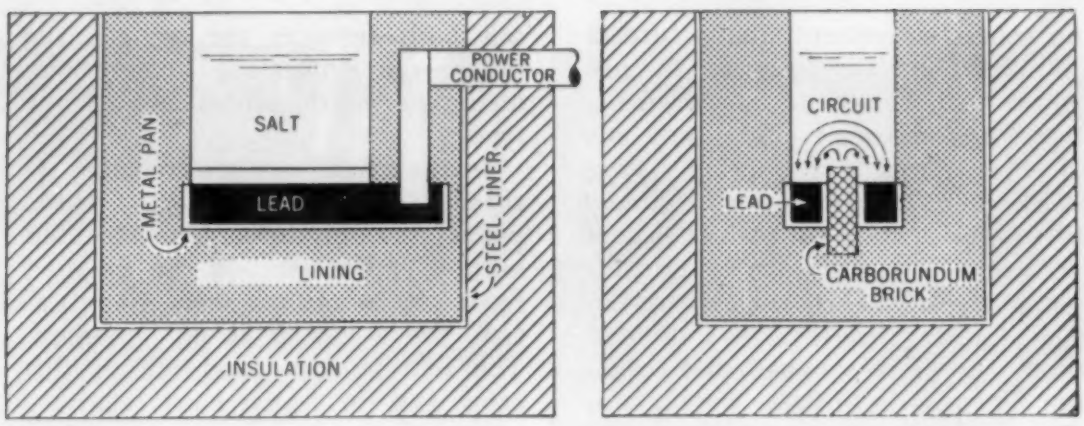
Two types of electrically heated salt bath furnaces are being made today—the immersion heating element type and the immersed-electrode type.

In the immersion-heater baths, resistance heaters heat the bath, and the pot is used only to contain the fused salts. This construction can be used from 300 to 1100 F, but its application above 750 F is not common. The efficiency is good within this range and the furnaces are relatively inexpensive to build.

The immersed-electrode type of furnace is the most important salt bath furnace today, from the standpoint of the quantity of work processed. It is responsible for many of the new applications of salt baths and is used in the vast majority of high production salt bath installations. There are now over 3500 im-

In completely mechanized salt baths the work is conveyed into and out of all baths. The time cycles are automatically controlled and all the operations are synchronized. In this jackrabbit mechanism the work is suspended from horizontal bars attached to the main run-around chain conveyor. Small chain conveyors transfer the work from one bath to another. The completed work is picked up by a conveyor and dried in the upper case section on its way back to the starting point. The same operator loads and unloads. (Ajax Electric Co.)





A recent electric salt bath furnace uses two parallel pools of lead as the immersed electrodes. This dispenses with the high nickel electrodes that were formerly required. The whole top area of the bath is usable in this design. (A. F. Holden Co.)

mersed electrode salt baths installed, with a connected load of over 300,000 kw.

The operating temperatures of these furnaces range from 350 to 2400 F. For baths operating at temperatures over 1600 F, this is the only practical furnace design.

The immersed-electrode furnace heats the bath by passing a low voltage (5 to 25 v) current through the fused salts. While most salts are insulators in the solid state, they become fairly conductive on melting. Only alternating current is used, since direct current would cause electrolysis in the bath.

Pots to contain the molten salts are made of welded steel for applications at 1300 F or less. For cyanide salts, steel pots are used up to 1800 F, but the neutral salts are contained in refractory pots in baths that operate at temperatures over 1300 F. Pot life is extremely long in the immersed electrode furnaces, averaging five years with refractory linings, according to one manufacturer.

The position of the electrodes and the technical details of the bath vary with the manufacturer. In the submerged-electrode design, the electrodes come through the wall of the pot at or near the bottom. The heat is thus generated at the bottom of the pot and the bath is heated by convection currents. The big advantage of this type of bath is the reduced area of the bath that is exposed to the air. To restart the bath after the salt has solidified, an auxiliary immersed resistance coil must be used to melt the salt.

The other type of immersed electrode furnace that is in common use has the electrodes close together at one side of the bath. The electrodes are closely spaced to provide electrodynamic forces in the current-carrying gap between. These forces give an automatic stirring action to the bath which sucks the liquid from the top and discharges it at the bottom—counter to the action of the convection currents operating in the rest of the bath. This circulation is claimed by the manufacturer to be so active that no measurable temperature gradient is present between the main body of the bath and the electrode vicinity. With this design the electrodes can be placed at or near the top of the bath so that they are partly exposed when the baths solidifies. To start, the user merely melts a small salt pool between the electrodes to take the first current. There is no danger, as there would be if the first melting were at the bottom of a solid bath. The dimensions of these salt baths are practically unlimited—baths up to 40 ft long are in commercial use.

Another factor contributing to the popularity of the electrode furnaces is the fact that they are relatively easy to mechanize. Practically all the moving parts of a conveying mechanism are outside the high heat zone. This is a decided advantage over radiant-heat furnaces.

Fuel-Heated Salt Baths

The oldest type of salt bath and the type still used in many installations is the fuel-fired bath. The weight of the metal processed by all the fuel-fired baths is less than 20% of the total salt bath production, however.

The simplest type of fuel-fired unit is the pot bath. This is a pot, suspended by its rim into a combustion chamber. The combustion chamber is heated by oil or gas flames, which ideally should not touch the pot surface. Since the heat is conducted to the salt bath through the pot wall, a considerably higher temperature must be maintained in the combustion chamber than in the bath itself. The pots are rectangular or round. The volumes vary from 0.25 to 12.0 cu ft in standard furnaces.

The fuel-fired pot furnace has a number of limitations. The bath temperatures are not usually run over 1600 F. At this temperature, the combustion chamber must be near 2000 F; the metal pot would fail in a short time with any further increase in temperature. Refractory materials cannot be used to protect the pot because they would, of course, cut off heat from the salt. Even with these temperature limitations, pot life is short, especially with the neutral chloride salts.

Fuel-fired pot furnaces are widely used because they have a number of advantages that overcome these limitations in many applications. Their biggest selling point is low cost. The comparatively low initial cost explains why the relatively short life of the pots can be tolerated in some cases. Pot furnaces can also be stopped and restarted without difficulty.

The immersed tube furnace is another type of fuel fired unit. The heat is transmitted to the salt bath from tubes running through the bath. These tubes carry hot combustion gases. An immersed tube furnace is similar to a pot furnace in that it can be stopped and started easily. It is also similar to the pot furnace in that the heating surfaces (in this case the tubes) must be bare metal, either plain or alloy steel. The presence of this bare metal and the heat transfer problems limit the practical operating limits of these baths to 900 F.

Within their temperature limits, however, immersed tube heaters are much more efficient (80%) than the best pot furnaces (7%). This efficiency allows the immersed tube furnaces to be applied to large quantity production, and a number of large furnaces are in operation.

Acknowledgments

Ajax Electric Co.
American Cyanamid Co.
E. I. du Pont de Nemours & Co. (Inc.)
The Mitchell-Bradford Chemical Co.
Upton Electric Furnace Co.
Surface Combustion Corp.
A. F. Holden Co.
Crown Chemical Corp.
Dempsey Industrial Furnace Corp.
American Gas Furnace Co.
Continental Industrial Engineers, Inc.
E. F. Houghton Co.

Materials Engineering File Facts

NUMBER 216
October, 1951

New Steel Compositions to Conserve Critical Alloying Elements

The new grades of steel developed to conserve manganese, nickel, chromium and molybdenum are given in these tables. This new listing supersedes that which was published in the April 1951 issue.

Boron Steels

Grade	Chemical Composition Limits, %					
	C	Mn	Si	Ni	Cr	Mo
14B35	0.33/0.40	0.70/1.00	0.20/0.35	.....	.....	.....
14B50	0.47/0.55	0.70/1.00	0 20/0.35	.....	.....	.....
14B52	0.47/0.55	1.20/1.55	0.20/0.35	.....	.....	.....
TS50B46	0.43/0.50	0.75/1.00	0.20/0.35	.....	0.20/0.35	.....
50B15	0.12/0.18	0.70/1.00	0.20/0.35	.....	0.35/0.60	.....
50B20	0.17/0.23	0.70/1.00	0.20/0.35	.....	0.35/0.60	.....
50B30	0.27/0.34	0.70/1.00	0.20/0.35	.....	0.35/0.60	.....
50B35	0.32/0.39	0.70/1.00	0.20/0.35	.....	0.35/0.60	.....
50B37	0.34/0.42	0.70/1.00	0.20/0.35	.....	0.20/0.40	.....
50B40	0.37/0.45	0.70/1.00	0.20/0.35	.....	0.35/0.60	.....
50B44	0.42/0.50	0.70/1.00	0.20/0.35	.....	0.35/0.60	.....
50B49	0.47/0.55	0.70/1.00	0.20/0.35	.....	0.20/0.40	.....
50B50	0.47/0.55	0.70/1.00	0.20/0.35	.....	0.35/0.60	.....
50B60	0.55/0.65	0.70/1.00	0.20/0.35	.....	0.35/0.60	.....
80B15	0.12/0.18	0.60/0.90	0.20/0.35	0.20/0.40	0.15/0.35	0.08/0.15
80B17	0.14/0.20	0.60/0.90	0.20/0.35	0.20/0.40	0.15/0.35	0.08/0.15
80B20	0.17/0.23	0.60/0.90	0.20/0.35	0.20/0.40	0.15/0.35	0.08/0.15
80B25	0.21/0.28	0.60/0.90	0.20/0.35	0.20/0.40	0.15/0.35	0.08/0.15
80B30	0.27/0.34	0.55/0.80	0.20/0.35	0.20/0.40	0.15/0.35	0.08/0.15
80B35	0.32/0.39	0.65/0.95	0.20/0.35	0.20/0.40	0.15/0.35	0.08/0.15
80B40	0.37/0.45	0.70/1.00	0.20/0.35	0.20/0.40	0.15/0.35	0.08/0.15
80B45	0.42/0.50	0.70/1.00	0.20/0.35	0.20/0.40	0.15/0.35	0.08/0.15
80B50	0.47/0.55	0.70/1.00	0.20/0.35	0.20/0.40	0.25/0.50	0.08/0.15
80B55	0.50/0.60	0.70/1.00	0.20/0.35	0.20/0.40	0.30/0.55	0.08/0.15
80B60	0.55/0.65	0.70/1.00	0.20/0.35	0.20/0.40	0.30/0.55	0.08/0.15
81B35	0.32/0.39	0.70/1.00	0.20/0.35	0.20/0.40	0.30/0.55	0.08/0.15
81B40	0.37/0.45	0.70/1.00	0.20/0.35	0.20/0.40	0.30/0.55	0.08/0.15
81B45	0.42/0.50	0.70/1.00	0.20/0.35	0.20/0.40	0.30/0.55	0.08/0.15
81B50	0.47/0.55	0.75/1.05	0.20/0.35	0.20/0.40	0.35/0.60	0.08/0.15
TS94B17	0.15/0.20	0.75/1.00	0.20/0.35	0.30/0.60	0.30/0.50	0.08/0.15
TS94B20	0.17/0.22	0.75/1.00	0.20/0.35	0.30/0.60	0.30/0.50	0.08/0.15
TS86B45	0.43/0.48	0.75/1.00	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15

Interim Alternate Steels

Grade	Chemical Composition Limits, %					
	C	Mn	Si	Ni	Cr	Mo
TS4012	0.09/0.14	0.75/1.00	0.20/0.35	.....	.....	0.15/0.25
TS4720	0.17/0.22	0.50/0.70	0.20/0.35	0.90/1.20	0.35/0.55	0.15/0.25
TS4130	0.28/0.33	0.45/0.65	0.20/0.35	.....	0.90/1.20	0.08/0.15
TS4132	0.30/0.35	0.45/0.65	0.20/0.35	.....	0.90/1.20	0.08/0.15
TS4135	0.33/0.38	0.75/1.00	0.20/0.35	.....	0.90/1.20	0.08/0.15
TS4137	0.35/0.40	0.75/1.00	0.20/0.35	.....	0.90/1.20	0.08/0.15
TS4140	0.38/0.43	0.80/1.05	0.20/0.35	.....	0.90/1.20	0.08/0.15
TS4142	0.40/0.45	0.80/1.05	0.20/0.35	.....	0.90/1.20	0.08/0.15
TS4145	0.43/0.48	0.80/1.05	0.20/0.35	.....	0.90/1.20	0.08/0.15
TS4147	0.45/0.50	0.80/1.05	0.20/0.35	.....	0.90/1.20	0.08/0.15
TS4150	0.48/0.53	0.80/1.05	0.20/0.35	.....	0.90/1.20	0.08/0.15

(Continued on page 137)

"B&W Allmul Firebrick keeps saving money for me!"

REORDERED... *for proven, continued economy*

- Welding furnace
- Non-ferrous reverberatory furnace
- Butt-weld furnace
- Slag melting furnace
- Dutch oven—French oxide furnace (zinc)
- High BTU gas generator
- Oil fired periodic ceramic kiln
- Car paving material for 3100F kiln
- Electric arc scrap-steel melting furnace
- Lead melting furnace
- High-speed gas-fired forge furnace
- Glass tank—port lining
- Glass tank—checker chamber
- Glass tank—port neck

Even under very severe service conditions, B&W Allmul Firebrick wins repeat orders! That's because this remarkable, electrically-fused mullite firebrick is low in cost . . . due to a special mass production process developed by B&W engineers.

Allmul stays on the job, too. It is designed to withstand temperatures up to 3200F with unequalled hot load strength. It has high resistance to spalling and slag. As a result, Allmul eliminates need for frequent furnace relining, cuts maintenance and saves valuable production time.

Investigate the money saving possibilities of B&W Allmul Firebrick. The sooner you start using Allmul, the greater your ultimate savings will be. SEND FOR NEW BULLETIN R-29.

ALLMUL *is another important refractories development by B&W engineers who have continuously established new standards in industrial furnace refractories for the past 30 years.*

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R-396

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Materials Engineering File Facts

Interim Alternate Steels—Continued

Grade	Chemical Composition Limits, %					
	C	Mn	Si	Ni	Cr	Mo
TS8115	0.13/0.18	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8117	0.15/0.20	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8120	0.18/0.23	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8122	0.20/0.25	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8123*	0.20/0.25	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8125	0.23/0.28	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8126*	0.23/0.28	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8127	0.25/0.30	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8128*	0.25/0.30	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8130	0.28/0.33	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8132	0.30/0.35	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8135	0.33/0.38	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8137	0.35/0.40	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8140	0.38/0.43	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8142	0.40/0.45	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8145	0.43/0.48	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8147	0.45/0.50	0.70/0.90	0.20/0.35	0.20/0.40	0.30/0.50	0.08/0.15
TS8150	0.48/0.53	0.75/1.00	0.20/0.35	0.20/0.40	0.35/0.55	0.08/0.15
TS8155	0.51/0.58	0.75/1.00	0.20/0.35	0.20/0.40	0.35/0.55	0.08/0.15
TS8160	0.55/0.62	0.75/1.00	0.20/0.35	0.20/0.40	0.35/0.55	0.08/0.15
TS8165	0.60/0.70	0.75/1.00	0.20/0.35	0.20/0.40	0.35/0.55	0.08/0.15
TS8615	0.13/0.18	0.70/0.90	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8617	0.15/0.20	0.70/0.90	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8620	0.18/0.23	0.70/0.90	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8622	0.20/0.25	0.70/0.90	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8625	0.23/0.28	0.70/0.90	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8627	0.25/0.30	0.70/0.90	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8630	0.28/0.33	0.70/0.90	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8632	0.30/0.35	0.70/0.90	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8635	0.33/0.38	0.75/1.00	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8637	0.35/0.40	0.75/1.00	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8640	0.38/0.43	0.75/1.00	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8641†	0.38/0.43	0.75/1.00	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8642	0.40/0.45	0.75/1.00	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8645	0.43/0.48	0.75/1.00	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8647	0.45/0.50	0.75/1.00	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8650	0.48/0.53	0.75/1.00	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8653	0.49/0.55	0.75/1.00	0.20/0.35	0.40/0.70	0.65/0.85	0.08/0.15
TS8655	0.50/0.60	0.75/1.00	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15
TS8660	0.55/0.65	0.75/1.00	0.20/0.35	0.40/0.70	0.55/0.75	0.08/0.15

** The sulfur content is 0.035/0.050*
† The sulfur content is 0.040/0.060

Alternate Steels

The following steels for cold heading and cold forging wires are proposed to conserve critical alloying elements. Grades 40B37 Modified, 8035, TS8135, 14B35, 5035 are for component sizes to ½-in. dia, inclusive. Grades 40B37, 80B37, TS8137, 50B37 are for component sizes over ½ to ¾ in. in dia, inclusive.

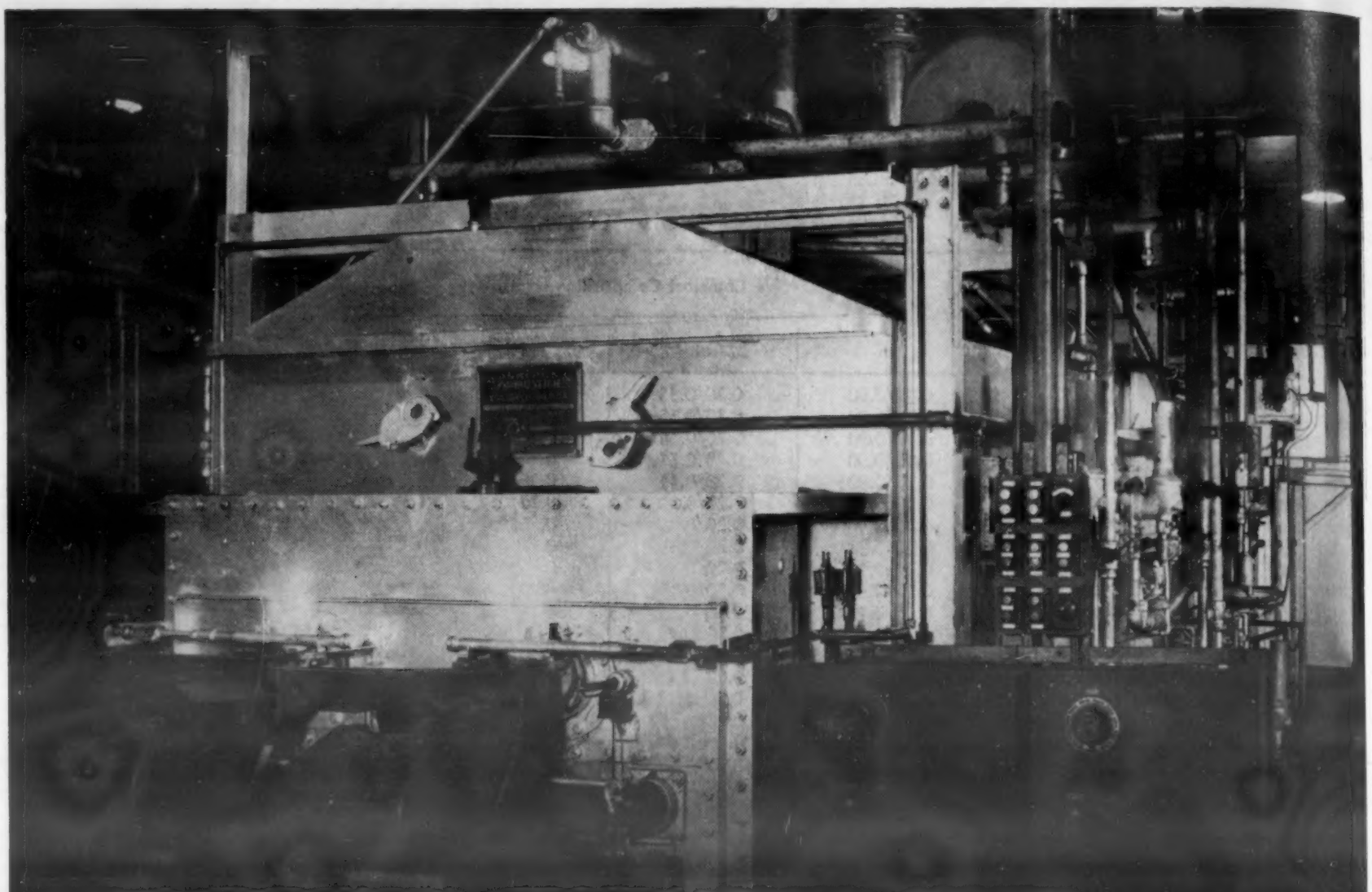
Grade	Chemical Composition Limits, %				
	C	Mn	Ni	Cr	Mo
40B37 Modified	0.34/0.42	0.70/1.00	.....	.....	0.08/0.15
8035	0.32/0.39	0.70/1.00	0.20/0.40	0.15/0.35	0.08/0.15
TS8135	0.33/0.38	0.70/0.90	0.20/0.40	0.30/0.50	0.08/0.15
14B35	0.33/0.40	0.70/1.00	.....	.....	.....
5035	0.33/0.40	0.70/1.00	.....	0.20/0.40	.....
40B37*	0.34/0.42	0.70/1.00	.....	.....	0.20/0.30
80B37	0.34/0.42	0.70/1.00	0.20/0.40	0.15/0.35	0.08/0.15
TS8137	0.35/0.40	0.70/0.90	0.20/0.40	0.30/0.50	0.08/0.15
50B37	0.34/0.42	0.70/1.00	.....	0.20/0.40	.....

** For aircraft applications*

Note 1. Grades 14BXX and 50BXX are boron steels not previously announced.
Note 2. Those steels designated as boron steels can be expected to have 0.0005% minimum boron content.
Note 3. The phosphorus and sulfur limitations for each steelmaking process are as follows:

Basic electric furnaces	0.025 max %
Basic open hearth	0.04 max %
Acid electric furnace	0.05 max %
Acid open hearth	0.05 max %

Note 4. Minimum silicon limit for acid open hearth or acid electric furnace steel is 0.15%.
Note 5. Small quantities of copper are present in alloy steels which are not specified or required. This element is considered incidental and may be present in an amount not exceeding 0.35%.
Note 6. The ranges and limits s n above apply to steel not exceeding 200 sq in. in cross-sectional area, or 18 in. in width, or 10,000 lb in weight per piece.



HOW SURFACE COMBUSTION HELPS CUT CARBURIZING COSTS

*with rotary retorts cast in Thermalloy**

A main part of the inside story of this Surface Combustion continuous carburizing furnace is the rotary retort we cast for it. Developed and built by Surface Combustion Corporation, these furnaces with Thermalloy retorts are operating successfully in a number of roller bearing and automotive parts plants.

To make sure small parts pass through the spiral cycle and are discharged at exactly the right time, the passage must be free from obstructions. No part can be allowed to "hang up" and carburize too deeply, since individual inspection of parts is impractical. Thanks to careful foundry practice and a unique method of cleaning castings internally, these 16′ retorts operate precisely as designed.

For retorts, furnace parts, trays, racks, pots, muffles—Thermalloy gives you more operating hours per dollar. Whatever your heat-and-abrasion-resistance problem, our engineers will help you select the right grade of Thermalloy, engineer the casting and foundry practices necessary to produce it for lowest cost service life. On your next problem, why not call in an Electro-Alloys engineer? Write Electro-Alloys Division, 2082 Taylor Street, Elyria, Ohio.

*Reg. U. S. Pat. Off.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION
ELYRIA, OHIO

New Materials and Equipment

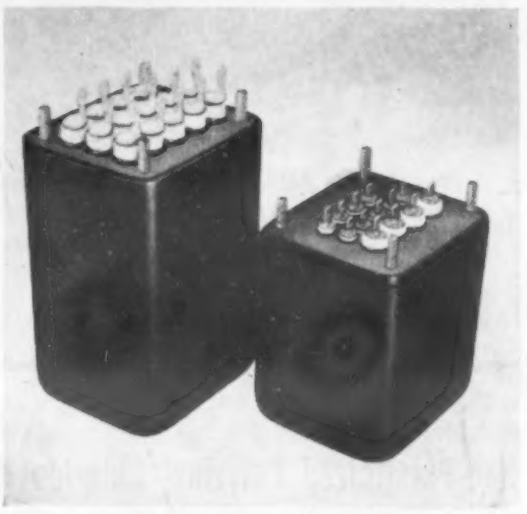
Silicone-Treated, High Temperature Electrical Insulation

Johns-Manville, 22 E. 40th St., New York 16, has announced an asbestos-base, silicone-treated, high temperature electrical insulation—a Class H insulation—as defined by AIEE standards for service at a temperature of 180 F.

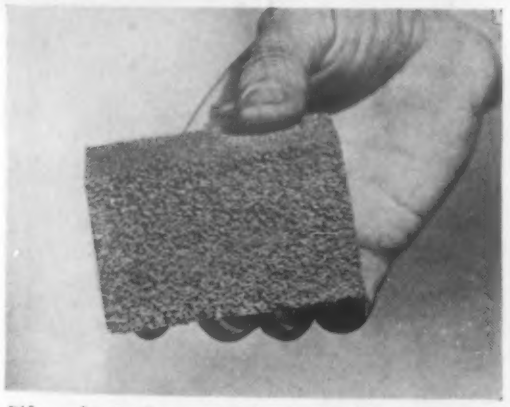
Quinterra Type 3 is designed for use for both inter-layer and wire wrapping insulation and is claimed to be adaptable to a wide range of electrical devices, including air cooled, inert gas and silicone-filled transformers.

This newest of the Quinterra insulations maintains a dielectric strength of at least 350 vpm under continuous exposure to Class H maximum temperature of 180 C. Furthermore, the dielectric strength remains practically constant even under continuously high humidity since the insulation has high moisture resistance. When it comes to application, Quinterra Type 3 is said to have excellent mechanical strength and physical properties. The base sheet of purified asbestos in completely inorganic and of closed structure with no holes. When silicone-treated, it is uniform in both texture and thickness. Thus, winding dimensions can be predicted accurately. Also, it is extremely flexible for easy handling during application and is resistant to cracking or crazing.

Available in the form of sheets, rolls and tapes in widths varying from ¼ to 36 in., and factory cut to specification, the newest of the Company's insulations can be used alone or it can be successfully combined with other dielectric materials, such as mica or glass cloth.



The transformer at right illustrates the savings in space and materials made possible with the new insulation.



The physical properties of this phenolic foam core material make it an ideal core material where high structural strength is required.

Phenolic Foam Core Material Possesses High Compressive Strength

Rezolin, Inc., 4825 W. Jefferson Blvd., Los Angeles 16, has announced a new phenolic foam core material with unusually high compressive strength, up to 500 lb psi.

Called Corfoam, the new material is a liquid phenolic resin which, when mixed cold, will foam to a hard consistency without applied heat at room temperature. It is of honeycomb appearance with tiny globular non-connecting cells and has a density of approximately 14 lb per cu ft.

An ideal material where high structural strength is required, Corfoam can be foamed in large masses without loss of cell control or undue shrinkage. It will not soften under heat, and tests show it has excellent insulating characteristics. Other properties claimed for the material are good adhesion to wood, paper and most plastics, will not support combustion, and low moisture absorption.

Chromium-Molybdenum Steel Electrode Aids In Aircraft and Ordnance Repair

The constantly increasing emphasis on the use of chromium-molybdenum steel not only for aircraft and ordnance, but in a host of other repair and production applications, is said to have been largely responsible for the development of a new electrode, EutecTrode 70, by *Eutectic Welding Alloys Corp.,* Flushing, N. Y.

According to the Company, the new welding alloy is a chromium-and-nickel content electrode that is specifically designed for repair and maintenance work. Its special composition, coupled with the Company's unique FrigidArc coating, is claimed to result in great ease of application in all positions and an extremely smooth arc action. Other advantages are said to include high tensile strength plus an unusually low amperage application that minimizes heat defects in the weld area.

EutecTrode 70 is manufactured in the following sizes: 1/16, 5/64, 3/32, ⅛, 5/32 and 3/16 in. dia.

This bumper illustrates a typical application of the new electrode.

Because of its flexibility and strong baked surface, Enamelstrip maintains its smooth, lustrous finish throughout the manufacturing process, as seen here.

Metal Coils Facilitate Production and Reduce Manufacturing Costs

Metal coils, pre-coated in color and precision slit to exact width, are claimed to be facilitating production and reducing manufacturing costs in a number of industries. The new product, Enamelstrip, is offered by *Enamelstrip Corp.*, 20th and Walnut St., Allentown, Pa.

The coil is available in cold rolled steel, electrogalvanized steel and electrolytic tinplate, brass, zinc and aluminum in any desired color or shade, coating on one or two sides. The process which binds the adhesive coating to the metal is said to enable the coil to withstand the stresses of drawing, bending, forming and fabricating without cracking or peeling.

According to the Company, the flexibility and adhesion of the chemically treated enamel coating provides unusual advantages in practically every type of stamping, molding and drawing by eliminating the need for many costly steps normally required for enameling or painting after the metal is formed. With the new product, cleaning, tumbling, spraying, dipping, rustproofing, baking and drying are all unnecessary.

Other advantages offered by the coils are: elimination from the production schedule of such processes as finishing, shearing and hand feeding; elimination of all waste; saving of space usually allocated for storing the metal because the Company's warehouses will stock orders, releasing them according to the manufacturer's production schedule.

Currently, Enamelstrip is being successfully used for such items as batteries, appliances, automobile parts and accessories, containers and screw caps, office equipment, marking devices, instrument parts and many others.

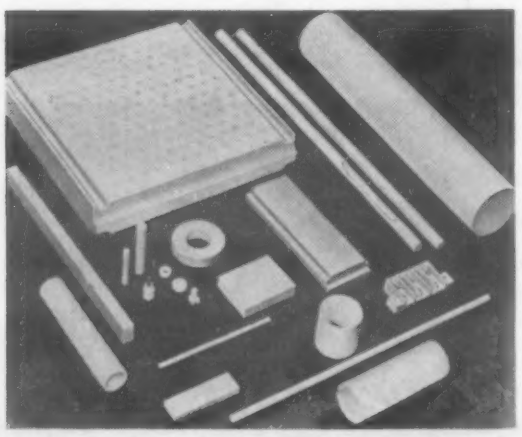
Non-Plasticized Polyvinyl Chloride Has High Acid Resistance

Lucoflex, a non-plasticized polyvinyl chloride material which can be easily welded, machined and formed, is currently being manufactured into rigid sheets, tubes, bar stock and molding powder by *Van Dorn Iron Works Co.*, 2685 E. 79th St., Cleveland 15.

The new material is claimed to offer many interesting properties. It does not go through the phenomenon of aging, and is resistant to almost all acids, alkalies and many special chemical solutions. Water vapors will not permeate the material. It is unaffected by temperatures between 177 F and 50 F below zero. Structurally, Lucoflex is of interest to design engineers because its weight is only one-half that of aluminum with about the same tensile strength. No industrial finish for protection against precipitation and fumes is needed with the use of the material as it is the same material throughout.

Already serving in a score of industries where resistance to acids and alkalies is essential, Lucoflex's major uses include tanks, tank liners, ducts and piping, in chemical operations, plating and metal pickling.

Here is the exterior of a plating tank lined with Lucoflex to make it impervious to sulfuric acid.



These parts have all been fabricated from the new ceramic material, Stupalith.

New Ceramic Materials Withstand Extreme Thermal Shock

A series of new ceramic materials able to withstand extreme thermal shock—primarily through exceptionally low coefficients of expansion—has been developed by *Stupakoff Ceramic & Manufacturing Co.*, Latrobe, Pa. Identified as Stupalith, the new material is being produced commercially in two principal types: with zero thermal expansion and with near-zero thermal expansion, either plus or minus.

The ability of Stupalith to resist expansion or contraction with changes in temperature has been vividly illustrated by a series of tests in which a sample was heated to 2000 F and plunged into liquid air, with the cycle being repeated 100 times without apparent harm.

Basically a wide series of lithium aluminosilicate compositions, the Stupalith group ranges from oxide compositions equivalent to mineral ercryptite, through the mineral petalite. Certain other compositions closely allied to lithium aluminate-silica also are considered part of the group.

Made from plentiful and non-restricted raw materials, the new ceramic can be formed by pressing, extruding, casting

"NO MORE STOOL STICKERS... SINCE WE STARTED USING NATIONAL TRADE-MARK GRAPHITE STOOL INSERTS!"

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NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.
District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco
IN CANADA: National Carbon Limited
Montreal, Toronto, Winnipeg

Other NATIONAL CARBON products

BLAST FURNACE LININGS • BRICK • CINDER NOTCH LINERS • CINDER NOTCH PLUGS • SKIMMER BLOCKS • SPLASH PLATES • RUNOUT TROUGH LINERS • MOLD PLUGS • TANK HEATERS

New Materials and Equipment

and ramming. It can also be press molded into tiny parts weighing a fraction of an ounce, as well as rammed or cast into large items weighing several pounds. By machining or grinding after firing, the dimension of Stupalith parts can be held to precise dimensional tolerances.

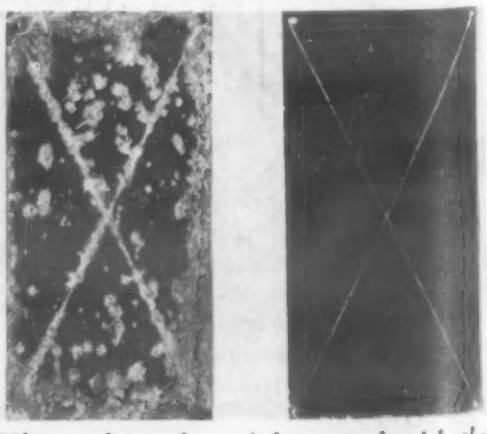
This new material can be used at temperatures up to 2400 F and is believed by the manufacturer to remain stable indefinitely. Its ability to withstand thermal shock makes it particularly adaptable for pickling bath containers, kiln furniture, induction heating, high temperature jigs and wire wound coil forms. Since its expansion can be controlled, it is also suitable for furnace liners and thermostat core rods.

In addition, parts made from zero expansion Stupalith can be used for plug-and-ring gages, mirrors, turbine blades and jet turbines, combustion engine parts and nozzle inserts. In its various forms, the new material is also recommended for pouring ladles for metals, electronic insulators, laboratory combustion boats and tubes, jet engine exhaust liners and other applications requiring controlled low positive or negative thermal expansion or resistance to thermal shock.

Phosphate Treatment for Metals Provides Corrosion-Resistant Paint Base

Hit-and-miss finishing techniques promise to become a thing of the past, according to *Octagon Process, Inc.*, 15 Bank St., Staten Island, N. Y., developers of a new phosphate compound for treating metallic parts.

The phosphatizing action of Anchorite 100 changes the surface of steel, iron,



The steel panel at right treated with the phosphate compound shows little sign of rust after a 12-month period of weathering exposure, while the untreated one shows extensive corrosion after 6 weeks.

NO TOLERANCE FOR DEFECTS LEAKS WEAKNESS

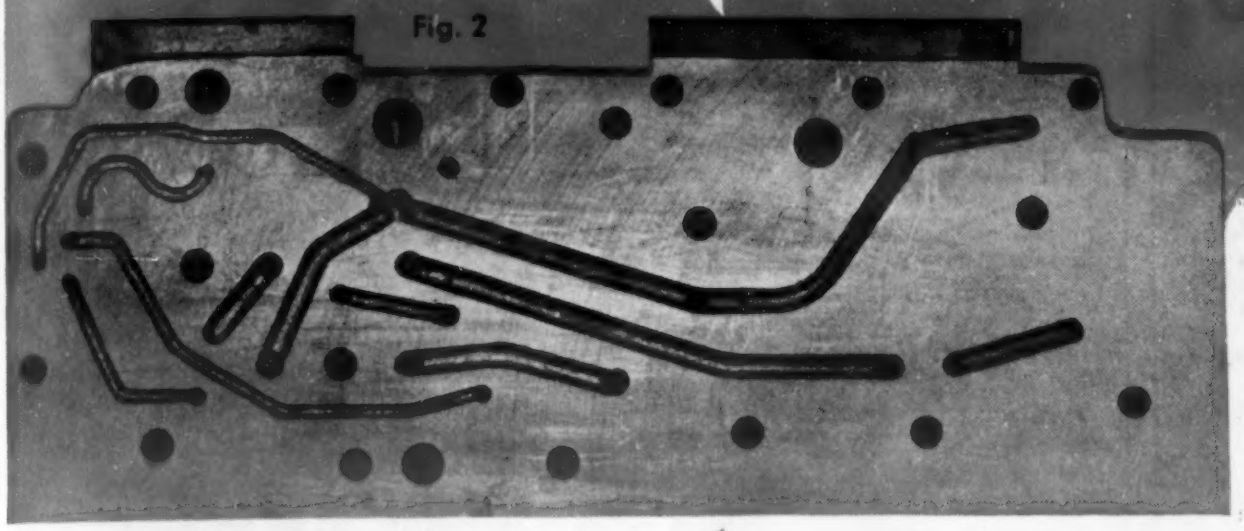


Fig. 2

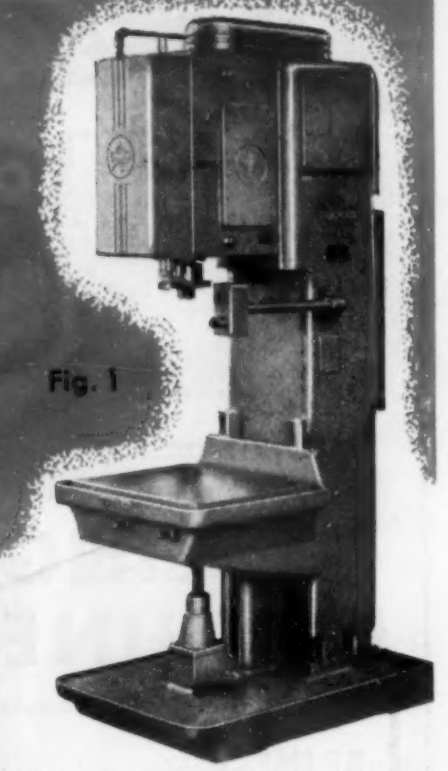


Fig. 1

Fig. 1—A Modern Tool Works Limited "Drillmatic".

Fig. 2—The Meehanite hydraulic manifold—the "heart" of the operating and control mechanism.

SPECIFIED MEEHANITE® CASTINGS

Take *YOUR* Casting Problem To A MEEHANITE FOUNDRY

American Brake Shoe Co.	Mahwah, New Jersey
The American Laundry Machinery Co.	Rochester, New York
Atlas Foundry Co.	Detroit, Michigan
Banner Iron Works	St. Louis, Missouri
Barnett Foundry & Machine Co.	Irvington, New Jersey
E. W. Bliss Co.	Hastings, Mich. and Canton, O.
Builders Iron Foundry	Providence, Rhode Island
Continental Gin Co.	Birmingham, Alabama
Crawford & Doherty Foundry Co.	Portland, Oregon
The Cooper-Bessemer Corp.	Mt. Vernon, Ohio and Grove City, Pa.
Empire Pattern & Foundry Co.	Tulsa, Oklahoma
Farrel-Birmingham Co., Inc.	Ansonia, Connecticut
Florence Pipe Foundry & Machine Co.	Florence, New Jersey
Fulton Foundry & Machine Co., Inc.	Cleveland, Ohio
General Foundry & Manufacturing Co.	Flint, Michigan
Greenlee Foundry Co.	Chicago, Illinois
The Hamilton Foundry & Machine Co.	Hamilton, Ohio
Hardinge Company, Inc.	New York, New York
Hardinge Manufacturing Co.	York, Pennsylvania
Johnstone Foundries, Inc.	Grove City, Pennsylvania
Kanawha Manufacturing Co.	Charleston, West Virginia
Lincoln Foundry Corp.	Los Angeles, California
E. Long Ltd.	Orillia, Ontario
Otis Elevator Co., Ltd.	Hamilton, Ontario
The Henry Perkins Co.	Bridgewater, Massachusetts
Pohlman Foundry Co., Inc.	Buffalo, New York
Rosedale Foundry & Machine Co.	Pittsburgh, Pennsylvania
Ross-Meehan Foundries	Chattanooga, Tennessee
Shenango-Penn Mold Co.	Dover, Ohio
Standard Foundry Co.	Worcester, Massachusetts
The Stearns-Roger Manufacturing Co.	Denver, Colorado
Traylor Engineering & Mfg. Co.	Allentown, Pennsylvania
Valley Iron Works, Inc.	St. Paul, Minnesota
Vulcan Foundry Co.	Oakland, California
Warren Foundry & Pipe Corporation	Phillipsburg, New Jersey

"This advertisement sponsored by foundries listed above."

The hydraulic operating mechanism of this "Drillmatic" drilling machine (Fig. 1) manufactured by Modern Tool Works Limited, Toronto, is of course the functional heart of the machine. Successful performance of such a mechanism is definitely dependent upon the hydraulic manifold (Fig. 2). In this and other types of drilling equipment the manufacturer specifies Meehanite castings for this part because of the design requirements for absolute density and high strength. The manifold is used for gasket mounting of various hydraulic control valves and the castings must withstand 1000 psi during operation.

In addition to this particular component the press shown is built with the following Meehanite castings:

1. **Table**
2. **Table Base**
3. **Fixtures**
4. **Retracting Bush Plates**
5. **Multiple Spindle Drill Head**
6. **Head Adapter**
7. **Motor Support Bracket**
8. **Hydraulic Unit and Base**

In the hydraulic unit the main body and cylinder are cast integrally and in Meehanite metal assure the required resistance to wear, pressure and high strength characteristics.

This equipment is another example of superior design in precision production tools made possible through the dependable and uniform *Quality* characteristics of Meehanite castings.

Write for our new booklet "25 Years of Proof in Service."

MEEHANITE®

NEW ROCHELLE, N. Y.

New Materials and Equipment

zinc and cadmium parts into an inert phosphate compound which is said to be highly resistant to corrosion and to provide an excellent base for organic coatings.

Application of the treatment to metal parts is inexpensive and simple, requiring no elaborate equipment. Applicable either by immersion or spray, it is easily adapted to both small and large production needs. The immersion process, which is most widely used, can be applied for both medium and small size production requirements. According to company engineers, the process utilizes a series of five tanks constructed of mild steel. Zinc and cadmium require only 30 sec to 1 min. in this process, while some steel alloys occasionally require as much as 5 min. The actual solution used is made by adding a small quantity of Anchorite 100 to a large volume of water.

The spray process is recommended for high-speed treatment of such products as automobiles, washing machines and bicycles. For this method, a five-step spray chamber machine is used. With such a setup, parts can be cleaned, phosphated and painted in rapid succession.

Although the new compound receives its largest volume application on ferrous parts, it is also finding wide acceptance as a pre-painting treatment on such metals as zinc, galvanized iron and cadmium. The adhesion of organic coatings directly on these surfaces is poor. An Anchorite 100 treatment, however, provides these metals with a paint-adherent, corrosion-resistant phosphate surface.

The compound meets the specification for a Class C (Type II) finish in U. S. Army Spec. No. 57-0-2C and the armed services specification JAN-C-490, Grade 1.

Electroplated Copper Sheet Wire Suitable for Many Applications

A new type of electroplated copper-on-steel wire which is suitable for a wide range of industrial, electrical and communications applications has been announced by *Kenmore Metals Corp.*, 380 Ninth St., Jersey City 2.

The new-type wires are said to be lighter and stronger than solid copper wires, which require 85% more copper. They provide electrical conductivity at high frequencies, which is comparable to that of solid copper wires, but have the advantages of increased dimensional stability, mechanical strength and light weight, which are important in conditions

New Materials and Equipment

of vibration encountered in mobile, aircraft, industrial and military electronic applications.

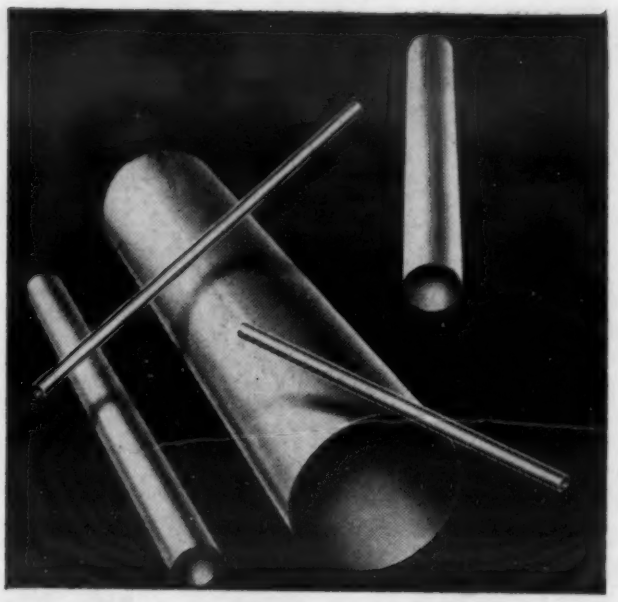
Copperon wires are produced by a patented continuous electroplating process which results in a uniform, perfect bond of pure copper to a steel core. The wires should not be confused with ordinary copper plated wires, as the coating here cannot be destroyed by changes in temperature, by pounding, by hot-rolling or by cold drawing. Relatively heavy cross-sections of the initial product are cold drawn to required diameters without change in the ratio of copper to steel or impairment of the bond between the two metals. Since the steel core is lighter than copper, Copperon wires provide about 10% more footage per pound than solid copper wires of the same outside diameter. They are available in practically any length and in diameters ranging from 3/8 in. to the finest wire gage sizes.

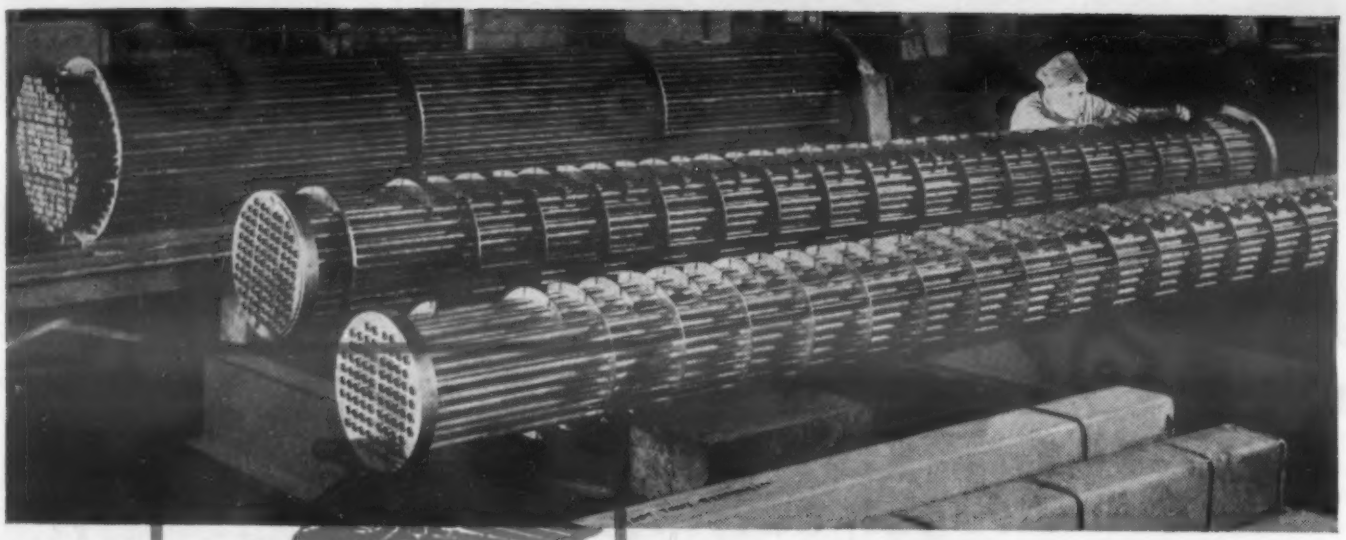
Applications for the new wires include: plating rack springs; float racks and lift rods for plumbing products, power transmission, telephone and railway signal lines; lightning rods; television antennas and transmission lines; coaxial cables; heavy-duty appliance cords; pigtail leads for capacitator resistors and many other industrial applications where stainless steel has been used because of its corrosion-resistant properties.

New Electrospray Process Gives Smoother Finish and Eliminates Paint Waste

A revolutionary new electrospray process designed to coat both metallic (ferrous or nonmagnetic) and nonmetallic (wood, glass, rubber, plastics) parts where production volume justifies consideration of a conveyorized finishing operation, has been announced by *Ransburg Electro Coating Corp.*, Barth and Sanders, Indianapolis 7.

Embodying the ionization principle, the process works briefly like this: The article to be coated is carried by a conveyor past the spray gun which feeds and charges the paint at the same time. The gun is a hollow coned-shaped head, hooked up to a power supply of 90,000 volts, that forces the paint to its outer edge by rotation. A source of electrostatic high potential having one terminal connected to the head creates a high-voltage field between the gun and the object on the conveyor. It is the force of this field which trans-





A. O. SMITH designs with TRENTWELD

When A. O. Smith, big name in steam and heat transfer equipment recently designed and built a heat exchanger unit for Socony-Vacuum — TRENTWELD Stainless Steel tubing was used throughout. This heat exchanger unit for use in the petroleum industry is another example of how TRENTWELD is preferred by designers for products where stainless steel tubing fits the bill.

And here's why: TRENTWELD is the product of tube specialists. That means you're assured uniform quality and specifications of manufacture that meet your most exacting needs. Then too, TRENTWELD is available in a full range of sizes—1/8" to 36" in diameter, in all grades and finishes. When the job requires stainless steel tubing, check with us.

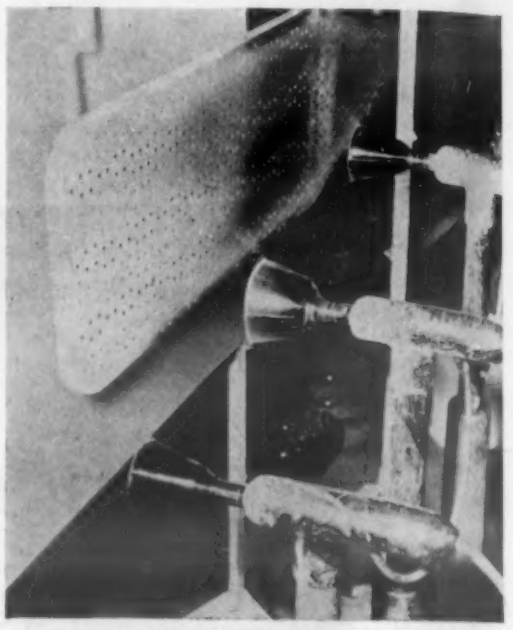
TRENTWELD STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN

(Subsidiary of Crucible Steel Company of America)

New Materials and Equipment

forms the coating material into a spray of fine charged particles which are pulled to the object.



Here metal ironing boards are enameled by the new process which cuts paint cost 25% per board over the original process and 58% over hand spraying.

The advantage of the new-type gun over the wired version is the elimination of such variables as atomization, air pressure, spray pattern, fluid delivery and exhaust air currents. Without these variables, the gun is claimed to deposit all the paint on the object with a more even finish and on most production lines the process is said to give 25 to 75% more pieces per gallon than other methods.

Besides ordinary paint, varnish and lacquer, the process also works with metallic paints as the coating material. However, because this type of paint is electrically conductive, and the spray gun used is supplied by a pump that's grounded, the paint is apt to ground the head and make it impossible to hold it at a high potential. In this case, it is recommended to insulate the pump and its paint supply above the ground.

Equipment for the No. 2 Process is furnished by the Company and operates from a 220-v, 60-cycle, single-phase supply.

High Strength-High Temperature Alloys Offered In Thin Gages

General Plate, division of *Metals & Controls Corp.*, Attleboro, Mass., is currently offering to industry the well known Hastelloy and Haynes corrosion resistant,

Optimum dust collection . . .

MIKRO-COLLECTOR
comprising 48 filter-cylinders of felt (A) and travelling reverse-jet ring (B). Manufactured under patent license from H. J. Hersey, Jr.

with AMERICAN Felt

The unique principles employed in the MIKRO-COLLECTOR enable dust recovery (up to 99.999%) and phenomenal filter rates. Pulverizing Machinery Company, Summit, New Jersey, the manufacturer, states that American Felt's wool felt has been found to be a superior filter medium, permitting the easy handling of damp or dry, light or heavy dust-loaded air streams. With the Hersey travelling reverse-jet principle uniform filter resistance is maintained, thus assuring uniform air flow. Used in the handling and recovery of a wide range of dusts and powders, the MIKRO-COLLECTOR serves to eliminate atmospheric pollution, as well as providing full recovery of a valuable product. Dangerous or noxious dusts and minute size dust particles are easily handled. Installations for the handling of ultra-fine radioactive dusts during the past year have a combined capacity of more than 100,000 cfm. The MIKRO-COLLECTOR is manufactured with single and multiple filter cylinders of varying diameters and lengths to meet every requirement.

American Felt Company
TRADE MARK

GENERAL OFFICES: 24 GLENVILLE ROAD, GLENVILLE, CONN. — ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn. — PLANTS: Glenville, Conn.; Franklin, Mass., Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I. — SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Dallas, San Francisco, Los Angeles, Portland, Seattle, Montreal

New Materials and Equipment

high strength, high temperature alloys in thin gages. These alloys are hot rolled by Haynes Stellite in thickness down to 0.050 in., and in some cases down to 0.025 in.

The four most widely recognized alloys and those which the company supplies in thin gages include:

- Haynes Alloy 25 (L-605)—Cobalt-base chromium-tungsten-nickel alloy
- Hastelloy B—Nickel-base molybdenum-iron alloy
- Hastelloy C—Nickel-base chromium-molybdenum-tungsten-iron alloy
- Haynes Stellite Multimet (N-155)—Iron-base cobalt-chromium-nickel-molybdenum-tungsten-columbium alloy.

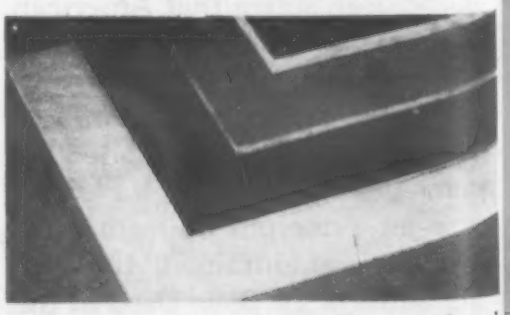
Standard width in which the Haynes alloys are processed is 6 in., although widths up to 8 in. can be furnished if required. The alloys can be supplied as desired in either random flat lengths or coils. At the present time maximum weight per strip is approximately 2 lb per in. of width.

The present critical availability of the materials used in these alloys requires that orders for production quantities carry a priority rating.

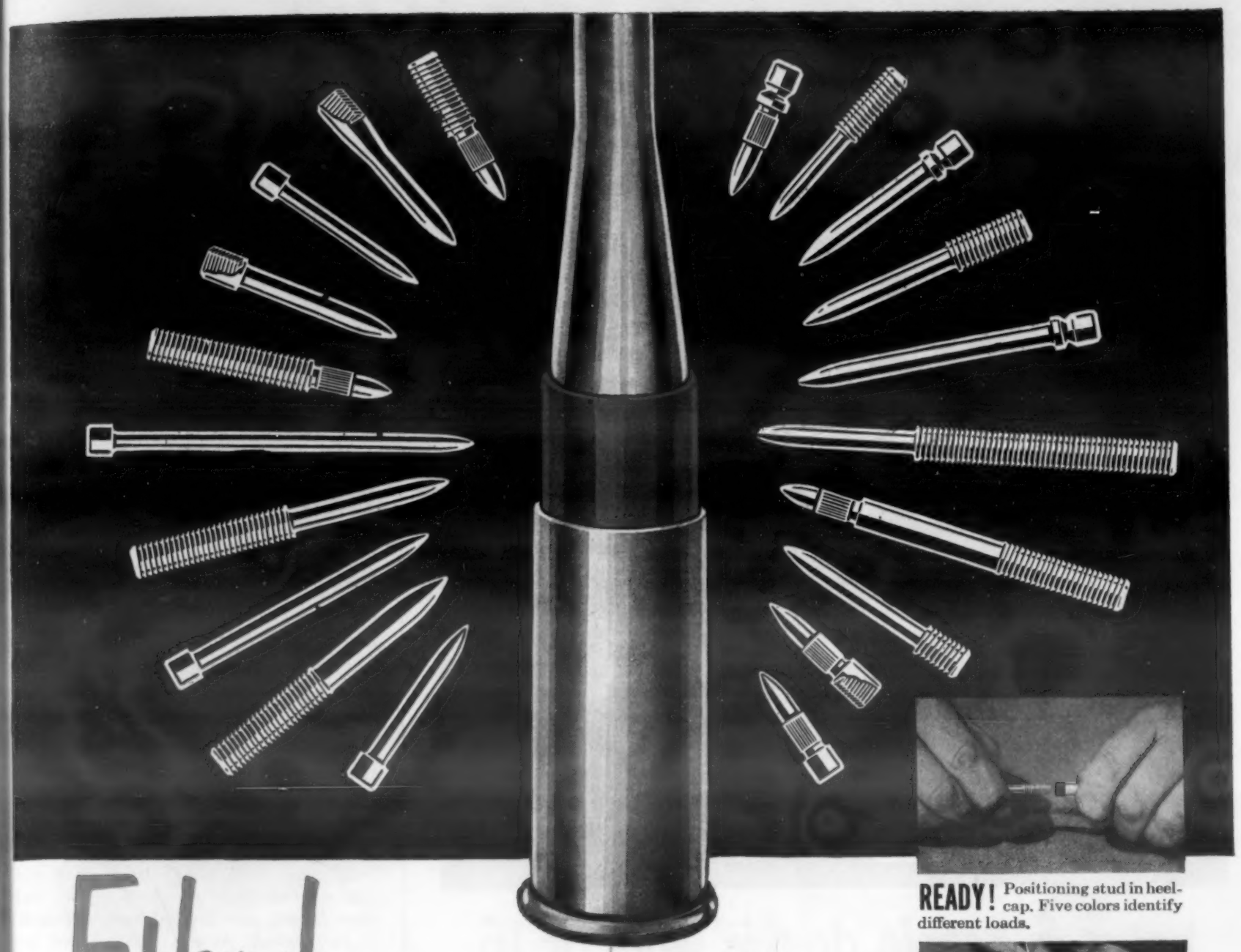
Plastics Offer Variety of Applications

Machining-grade glass-fiber reinforced plastic sheet, A3A, said to have punching and machining qualities similar to brass while retaining the outstanding properties of this line of glass-polyester plastic, is currently being offered by *The Dynakon Corp.* 5509 Hough Ave., Cleveland.

The sheet, available in 1/8-, 3/16- and 1/4-in. thickness, has a tensile strength of 11,900, compressive strength of 14,300, and impact of 10.3. Chemically resistant to acids, salts and mild alkalies as well as to most organic solvents, the plastic has a water absorption of only 0.39%. Electrical

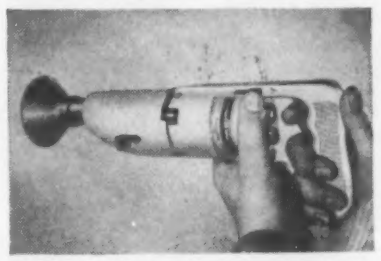


This machining-grade glass-fiber reinforced plastic sheet is said to be chemically resistant to acids, salts and mild alkalies.



READY! Positioning stud in heelcap. Five colors identify different loads.

LOAD! Loading Driver. Triple safety device prevents accidental firing.



FIRE! Driver requires no auxiliary power, has minimum recoil.

Ethyl CAPS THEM ALL!

Ethyl cellulose caps this cartridge, the ammunition for one of industry's newest power tools—the Remington Stud Driver. A tiny heelcap molded with Hercocel* E positions a hardened steel stud driven by an explosive force capable of penetrating structural steel ¾-in. thick.

For this demanding job, no other plastic affords, at comparable cost, all the advantages of Hercocel E. It won't crack or shatter when the Driver is fired. There's no pickup of the plastic in the gun barrel. Hercocel E will retain its shape under widely varying climatic conditions and during long periods of storage, yet is resilient enough to assure a snug fit for twenty different types of studs produced to commercial tolerances.

Hercocel E takes tough jobs like this in its stride. Perhaps this versatile, quality plastic can help you. Hercules will be glad to provide design and technical assistance in adapting it to your individual needs. Your inquiries are invited.

- MOLDABILITY
- SHOCK RESISTANCE
- DIMENSIONAL STABILITY
- LIGHTWEIGHT
- COLORABILITY

HERCULES POWDER COMPANY *Cellulose Products Department, 996 Market Street, Wilmington, Del.*

HERCULES Cellulosic Plastics

*TRADEMARK

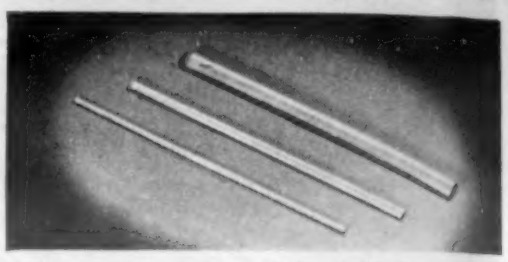
Plastic heelcap molded with Hercocel E by Consolidated Molded Products Corp., Scranton, Pennsylvania, for Industrial Tool Division, Remington Arms Company, Inc., Bridgeport, Conn.

CP51-7

New Materials and Equipment

properties of interest include dielectric strength of 325-v per mil, arc resistance of 120-sec, and power factor of 4.24.

High strength plastic rod in fractional sizes has also been announced by Dynakon. The new rod is molded of Dynakon-F, a high tensile strength material of



These rods are formed from high strength plastic in fractional sizes.

excellent electrical and corrosion resistant properties. Tensile strength is 100,000 psi, compressive strength is 70,000 psi, and flexural strength is 150,000 psi. Among electrical properties, arc resistance is 120 sec ASTM, dielectric strength is 280-v per mil and power factor is 2.5.

The rods are said to be resistant to acid and mild alkalies as well as to salts and most organic solvents. Salt spray resistance is outstanding. Among recommended applications are stand-off insulators, tension rods, supports in chemical equipment and structural members in corrosive atmospheres.

New Polymers Offer Unusual Adhesion Properties

Metals, ceramics and glass can be adhered to themselves as well as to other materials, such as wood, cloth, synthetic rubber and paper, with a new class of adhesives, according to *Polymer Industries, Inc.*, Astoria, N. Y.

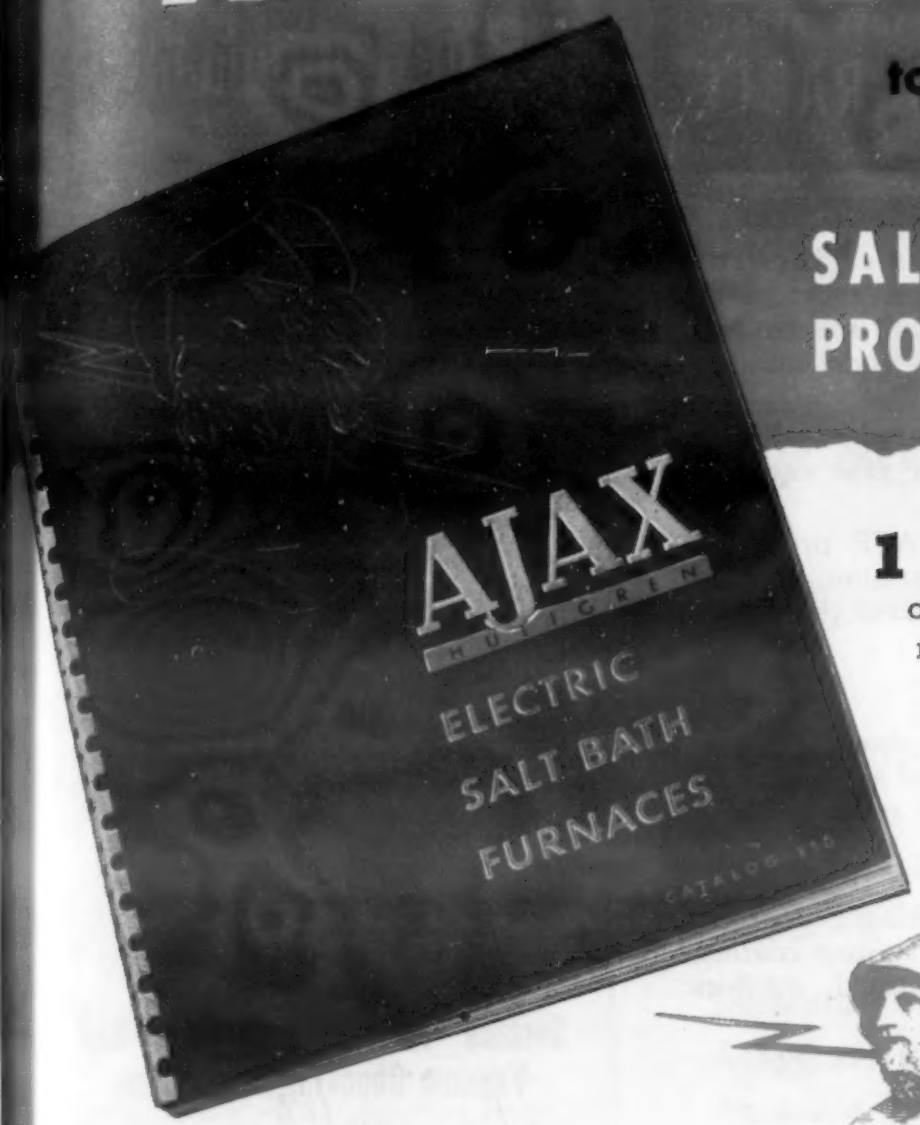
The new resins, known as Pylene adhesives, are available as powders, prepolymer liquids and as solvent solutions, and can be supplied in one part containing catalysts already incorporated, or as two parts to be mixed prior to use. Some grades can be converted to very hard and tough plastics without the use of heat, while others can be polymerized only by heat.

In addition to the unusual bonding properties claimed for the resins, they also are extremely interesting because of their resistance to solvents, chemicals, abrasion and heat. They are said to be virtually unaffected by aqueous acids or alkalies, by gasolines or oils, or by other solvents. They are tough and horny plas-

A 2-WAY OFFER

to those who have not yet fully investigated the amazing

SALT BATH HEAT TREATMENT PROGRESS OF THE PAST 5 YEARS



1 Write today on your company letterhead for a free copy of the 72-page Ajax data booklet "Electric Salt Bath Furnaces." Here you will find the complete, fully-authenticated story of exactly how and why these famous furnaces surpass any other type of heat treating equipment in quality, speed, and economy, in *4 cases out of 5*. And you will also find a wealth of heat-treating data that may go far toward putting this phase of your production on a sounder basis.

2 Choose your furnaces on the basis of actual proof, not on mere claims. Send—or bring—a specimen batch of your work for treatment in the full-commerical scale Ajax Metallurgical Service Laboratory. Learn exactly what you can expect from this method in specific terms of improved physical properties, faster production, less floor space, lower labor costs, reduced maintenance and greater efficiency all along the line. There is not the slightest cost or obligation on your part. Write or wire today.

AJAX ELECTRIC COMPANY, INC.

906 Frankford Avenue • Philadelphia 23, Pa.

The World's Largest Manufacturer of Electric Heat Treating Furnaces Exclusively

AFFILIATED COMPANIES

Ajax Electro Metallurgical Corp.; Ajax Electric Furnace Corp.; Ajax Engineering Corp.; and Ajax Electrothermic Corp. (IN CANADA: Canadian General Electric Co. Ltd., Toronto, Ont.)

See Us At the Metal Show—Booth F-421

AJAX
HULTGREN

ELECTRIC SALT BATH FURNACES

More Dependable . . . More Economical
On 4 Applications out of 5

AJAX OFFERS

ABSOLUTE QUALITY CONTROL

FASTER PRODUCTION IN LESS SPACE WITH UNSKILLED LABOR

MAXIMUM EFFICIENCY AND ECONOMY IN EVERY STEP OF THE WORK

for: Carburizing • Cyanide Hardening
Neutral Hardening • Hardening High Speed Steel
Annealing or Hardening Stainless Steel • Brazing
Austempering • Martempering • Process Annealing
Cyclic Annealing • Solution Heat Treatment
Tempering • Descaling • Cleaning • Desanding

New Materials and Equipment

tic materials when set, and can resist vibratory forces.

One of the virtues of bonds made with the new adhesives is their electrical resistance. They have inherently excellent properties in relation to dielectric strength and volume resistivity.

This combination of properties of the Pylene resins suggests their use in a variety of new applications, some of which have never been satisfactorily solved before. These applications are to be found in the following fields: can lining and seaming; non-conductive soldering; sealing of castings; coating of wire; optical cement; adhering Neoprene to plastics; inserting resistant liners into bottle, tube and jar caps; bonding aluminum to itself; adhering copper to masonite; and cementing gaskets.

Surface Finishing Machine Has Vacuum Chucking Mechanism

A surface finishing machine capable of holding non-magnetic items without interference with coverage over the entire surface has been introduced by *Clair Manufacturing Co.*, 1033 S. Union Ave., Olean, N. Y. While holding magnetic products in position with a magnetic chuck is standard procedure, the Model 203 machine,

This surface finishing machine is recommended for finishing such non-magnetic products as compacts, lithograph sheets, flatiron sole plates, blanking stock and fan blades.

with its vacuum chuck, is claimed to be the answer to the problem of holding items made of brass, copper, silver, plastic, aluminum, wood and other non-magnetic materials.

This horizontal, electrohydraulic machine has a moving work table consisting of a perforated plate mounted over a

(Continued on page 157)

New Materials and Equipment

sealed air space which is connected to a vacuum pump through a four-way spring-return valve. Offering a maximum working area of 38 by 36 in., the perforated plate is covered by a rubber mat. In operation, the table moves both in and out and sideways under the revolving buff spindle. The length of the in and out stroke of the vacuum table is adjustable from ¾ to 36 in., sideways ½ to 1¾ in. Without interfering with the vacuum action, raised pads, conforming to the contours of the parts being finished, eliminate the danger of buffs coming in contact with the mat.

Said to be practically immune to abrasives, the unit can be supplied with 5-, 7½-, 10- or 15-hp motors. Buffs up to 12 in. in dia. and 40 in. in length can be mounted on the spindle, while an air circuit provides automatic float of buff at any predetermined uniform pressure.

Bright Dip for Nonferrous Metals

A safe bright dip for brass, copper, bronze, nickel silver, phosphor bronze, beryllium copper and most copper alloys which is now in accord with A/N, AF, ORD and AEC specifications for bright dips on nonferrous metals is offered by *Rossul Co.*, 170 Fifth Ave., New York 10.

Advantages claimed for the dip include:

1. After clear water rinse, leaves no residue that interferes with conductivity.
2. Leaves nonferrous metals in a passivated state resistant to further oxidation.

Welding Head for Dissimilar Metals

Design of a new welding head to be used for welding dissimilar metals in the assembly of radio and other electronic tubes, as well as for the assembly of other small metal parts, has been announced by *Raytheon Manufacturing Co.*, Waltham 54, Mass.

The new Model I-S Weldpower Head is a bench mounted, press type unit with single post mounting. Accurate electrode pressure is made possible through the use of a closed air system using a metal bellows, and instantaneous electrode follow-up is achieved by keeping the mass of the moving parts of the upper electrode

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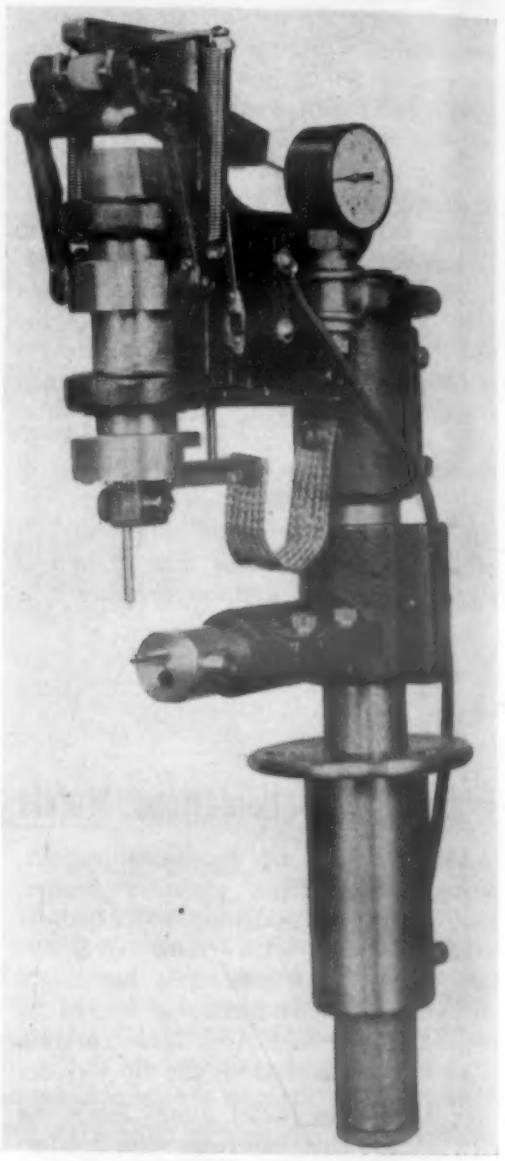


This new welding head can be used for welding dissimilar metals in the assembly of radio and other electronic tubes, as well as for the assembly of other small metal parts.

assembly extremely low. This feature is said to make possible many welds that are not possible with high inertia heads.

Small and compact, the model is extremely flexible in application. Either 1/8- or 1/4-in. electrodes can be used interchangeably, while a simple electrode clamp makes electrode changing fast and easy.

High Dielectric Strength Insulating Material

A new fibrous insulating material which is said not to blister when covered with hot compounds has been announced by *Rogers Corp.*, Manchester, Conn.

Designed for use with electrical components which must be hermetically

How True To This Form Is Your Present Casting Source?

	(CHECK HERE) TRUE	FALSE
1. Our present casting source provides the highest financial rating based on sound principles of operation.	____	____
2. It has the necessary facilities to supply both aluminum permanent mold **and** aluminum and zinc die castings from one source.	____	____
3. It offers independent facilities for finishing and complete product assembly.	____	____
4. It offers swift field service through strategically located sales engineers, **directly and exclusively company-employed.**	____	____

MONARCH PASSES THIS TEST 100%

These essential qualities of efficient operation are among the advantages Monarch offers to industry. Nationally-known manufacturers recognize their importance and rely on Monarch's outstanding facilities for casting, finishing and product assembly. Although fulfilling defense requirements takes precedence in its program, Monarch operations are geared to carry more than a normal share of the load on important civilian production of aluminum permanent mold, aluminum and zinc die castings. If you need assistance in difficult production scheduling, we are certain these facilities can benefit you.

Write today for Monarch's FACT FILE for design, purchasing and production executives. It's valuable source file material.

MONARCH ALUMINUM MFG. COMPANY • **Detroit Avenue at West 93rd Street, Cleveland 2, Ohio**

New Materials and Equipment

sealed, the new material, Duroid 705, is claimed to eliminate the development of weak spots in the insulating barrier as a result of blistering, a difficulty that has been both troublesome and hard to detect.

The first application of the material has been in fluorescent ballasts. In this application, the material is covered with asphalt heated to 225 C. The improved insulation provided by Duroid 705 permitted the manufacturer to use a single insulating part instead of the two-piece assembly previously employed.

The new material is one of a group of special fibrous sheet products developed by the Company to blanket the range of materials characteristics from laminated plastics through vulcanized fibre, to paperboard.

Low Cost Plasticizer for Vinyl Compounds

Currently being offered by *Hooker Electrochemical Co.*, Niagara Falls, N.Y., a new low cost plasticizer for vinyl compounds, MPS-500, is designed for use in such formulations as sheeting, wire covering, shoe soles and other compositions which must withstand severe stretching and flexing.

The compound can be used alone or in conjunction with other plasticizers. It imparts flame retardance and has high permanence on heat aging, and aging in oil, gasoline and water. In addition, it is claimed to possess excellent electrical properties and adds high strength together with good low temperature flexibility to wire insulation, films and coating compositions.

Flux-Coated Aluminum Welding Rods Match Base Metal

High quality, flux-coated aluminum welding rods for oxyacetylene and oxyhydrogen welding have been released by *Eutectic Welding Alloys Corp.*, 172nd St. and Northern Blvd., Flushing, N. Y.

For architectural structures and many other applications where an anodized silicon bearing welding rod has always shown an objectionable dark weld, the new EutecRod 22FC is said to provide a base metal matching solution since corrosion resistance and color, as well as physical properties of the weld, are said to closely match the aluminum. The flux

New Materials and Equipment

coating is low melting to provide for minimum heat application, and once melted, flows in a transparent pool, permitting the welder to easily watch the progress of the work while eliminating the stoppages that occur when a rod with separate flux is used.

New Molding Machine Features Push Button Control

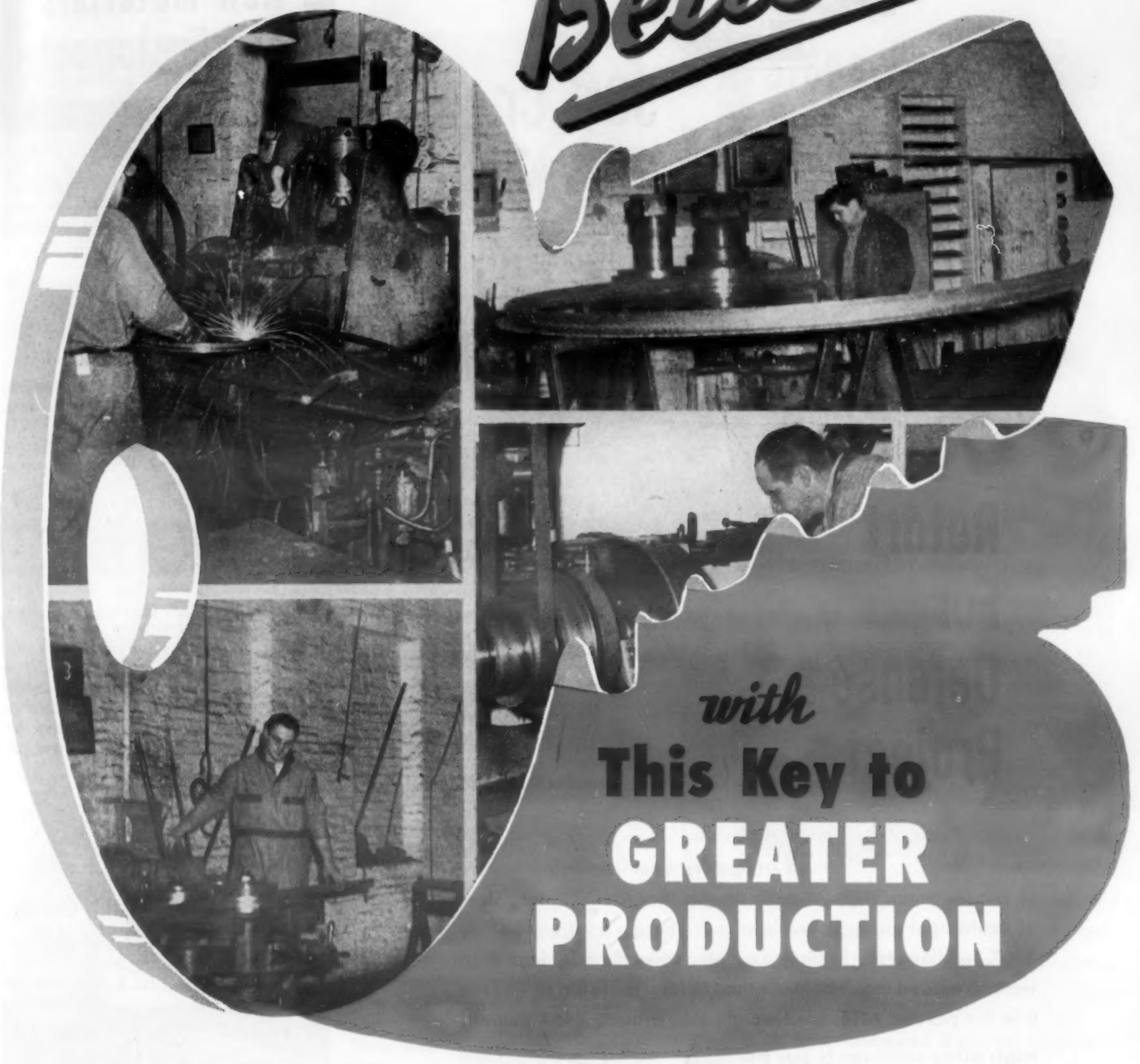
What is claimed to be the world's largest jolt-squeeze-strip molding machine for the production of massive copes and drags of uniform standard is currently being offered by *SPO Inc.*, 6536 Grand Division Ave., Cleveland 25.

Designated Model 2364, the new unit features centralized control of all operations from a conveniently located push-button stand. Operating on standard 80 psi, the machine has a squeeze capacity of 80,000 lb and jolt capacity of 4000 lb. Squeeze diameter is 36 in., patter draw 14 in., and squeeze piston stroke is 14 in. Flask space ranges from 38 in. min to 54 in. max, left to right, and from 32 to 50 in., front to back.

For maximum efficiency and precision, the 2364 incorporates automatically controlled operation. The squeeze head is power operated, the jolt cycle timer-controlled and the squeeze cycle regulated by

This unit is claimed to be the world's largest jolt-squeeze-strip molding machine, and features automatic control of all operations.

LOCK UP THE *Better* JOBS



Stands to reason you can't handle many *more* jobs but you can take on better *quality* jobs . . . jobs which return a better profit . . . jobs which demonstrate your top ability.

Well, you can go after and lock up the better jobs when you select King to supply your ring requirements. King bends and welds from bar stock, bands, flanges, angles, special shapes to your specifications. Make King your ring department. Save time, money, material, labor. A phone call, a wire, a letter will start King working as your Ring Department.

King **FIFTH WHEEL COMPANY**
2915 N. 2ND ST., PHILADELPHIA 33, PA., NE-4-2444

New Materials and Equipment

a pressure switch. The two-speed vibrating and stripping operations are automatically controlled to eliminate dependence upon the operator's judgment.

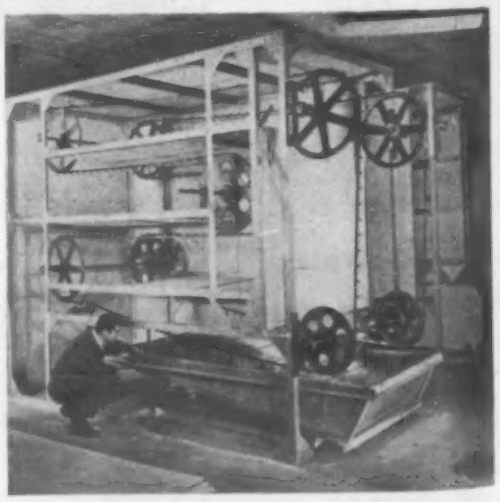
New Switch Contact Material

Designed to save switch manufacturers time, worry and money, the new switch contact material offered by *D. E. Makepeace Co.*, Attleboro, Mass., consists of precious metal slugs brazed into strip stock and positioned to form the desired part.

This new material is said to be particularly adapted to rotors in switches and small bridge contacts and to any formed part embodying two or more contact points. Of great importance is its hardness and wear resistance due to cold working. Among applications already used is a rotor with three precious metal contact caps made for a leading automotive manufacturer. Previously used soldered-on caps had proved soft and expensive, but the new material is claimed to have provided the ideal solution.

Automatic Dipping and Drying Machine Produces Quality Coatings

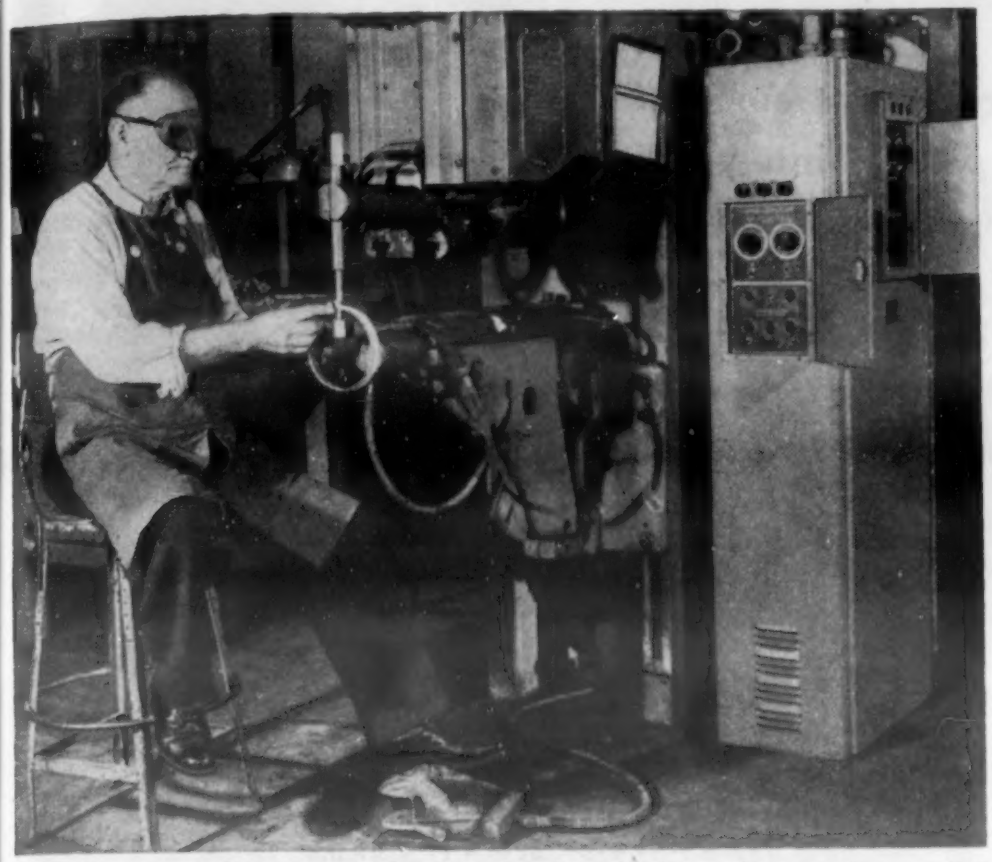
Applied Engineering Associates, 139 E. 57th St., New York 22, has developed a new, versatile automatic dipping and drying machine which is said to coat articles with paint, lacquer or varnish and produce tear-free, drain-free and drip-free surfaces of uniform thickness.



This automatic dipping and drying machine is presently being used in industry for the processing of toys, novelties, jewelry and hardware.

The process is accomplished by means

Solar Aircraft Welds Close to the Edge



Material does not split out, spattering is reduced on this jet engine part because G-E slope control permits a gradual increase in welding current that also reduces tip pick-up and spatter. More welds can be made before electrodes must be cleaned. Welds are sound and uniform. Bulletin GEC-534.

G-E Slope Control for Resistance Welding Prevents Split-outs on Stainless Steel Jet Engine Parts

More precise work possible with this resistance welding accessory used with G-E synchronous control.

Be sure of consistent, high-quality welds with these G-E Accessories

DETERMINE THE BEST TIMING FOR A JOB **Portable, inkless G-E cycle recorder makes a record of the exact timing on test welds, is then used as a check to verify the setting on machines in production. Bulletin GEC-376.**

HOLD WELDING CURRENT CONSTANT **Regardless of line-voltage variations of as much as plus 10 per cent and minus 20 per cent, the G-E electronic voltage-regulating compensator holds welding current constant. Bulletin GEA-4223.**

REDUCE BRITTLENESS **Heat treat medium-carbon, low-alloy, or high-alloy steel with G-E tempering control. Easily installed and operated. Adjustable to suit thickness and type of metal welded. Bulletin GEA-4201.**

MEASURE ELECTRODE FORCE **Check existing gages on spot, seam, or projection welders or at time of set up. Easy to use, saves time, acts as a production check. Force range: 0 to 4500 pounds. Small, portable. Bulletin GEA-3628B.**

PREVENT CURRENT VARIATIONS **Where the insertion of magnetic material in the throat of the welding machine causes weld variations, the current-regulating compensator keeps current constant to within plus or minus two percent. Bulletin GEA-4207.**

Solar Aircraft, like many other plants working on jet engines, has found G-E synchronous control, with slope control added, will enable operators to work to closer tolerances, produce faster, with fewer rejects. The part shown is welded close to the edge but does not split out, and spatter is reduced on both stainless and mild steel.

Use G-E Synchronous Control wherever AN-W-30 and 32 specifications must be met. It assures consistently uniform high quality welds—operates quietly, requires little maintenance. Like all G-E electronic equipment, it has long life, is enclosed in a compact unit that may be mounted on the welding machine or wherever convenient. Easily inspected. Write today for Bulletin GEA-4699. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

645-54

New Materials and Equipment

of automatically controlled extraction angles and rates from the dip tank and then drying in a forced draft controlled atmosphere. These factors are adjustable for viscosity of coating, size of piece and production requirements. Positioning of the piece with respect to the carrying rack is pre-determined to eliminate any accumulation of lacquer in reverse curve horizontal sections.

New Replacements for War Scarce Chemical Solvents

Announcement of a solvent possessing high grease cleaning and carbon removing properties has been made by *Curran Ordnance Chemical Laboratory,* Lawrence, Mass.

The new product, which is designed to clean carburetors, fuel pumps, Deisel Injectors, pistons, oil strainers and metal parts, is a novel di-phase solvent and comprises a water emulsion floating top layer sealing a volatile chlor-aromatic solvent lower layer.

According to the laboratory, the performance of this new di-phase solvent is substantially faster and will produce more complete and quicker results than can be obtained from present chlorinated type vapor degreasing solvents. Also, where chlorinated solvents can no longer be obtained because of critical shortages, the new solvent can be used as a replacement.

Another important feature of the solvent is its safety to personnel characteristics as its top water-emulsion seal prevents direct contact with skin, such as dipping the hands or splashing the active lower layer solvent directly into the eyes. In addition, both phases are completely water soluble in an event of a fire; the solvent will simply rinse away as a solution of liquid soap when a sprinkler is applied to it.

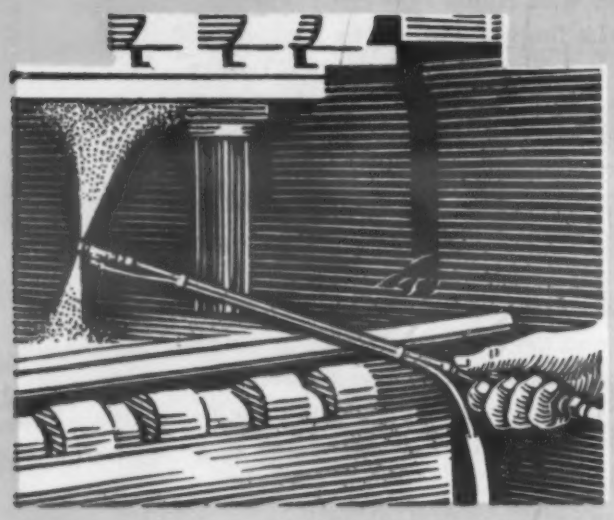
Sheet Metal Tester for Erichsen Test

A new sheet metal tester which is said to determine the actual workability of ferrous, nonferrous and fine metal sheets and strips to the point of fracture has been introduced by *J. Arthur Deakin & Son,* 150-28 Hillside Ave., Jamaica 2, N. Y.

In operation, a test piece is clamped between two dies and is held so that the metal has "play" and can flow, while a

(Continued on page 170)

NO SMOKE... NO FUMES
in Hot Forging with...
"dag" Colloidal Graphite



"Dag" colloidal graphite dispersed in water eliminates smoke and fumes in hot forging operations . . . greatly improves working conditions. The lubricating properties of colloidal graphite are superior, too, giving increased production . . . reduced die wear . . . better finish . . . and usually a saving in steel stock.

The uses of **"dag"** colloidal graphite for hot forging operations are fully explained in a specially prepared article entitled "Forging Die Lubrication". Copies are available without obligation. Write today to Acheson Colloids Corporation, Port Huron, Michigan, for Bulletin #750-18K.

dag
DISPERSIONS®

Acheson Colloids Corporation

Port Huron, Mich.

...also Acheson Colloids Limited, London, England

New Materials and Equipment

perfect round-end tool is moved forward gradually by the hand wheel until fracture occurs. The operator is able to see the image of the test piece in a mirror at all times, and when fracture appears, the depth of the impression is read directly from a micrometer scale. Readings can be obtained accurately to 0.0004 in. The depth of the impression required to obtain fracture represents the standard value which

This metal tester is used to determine the workability of ferrous, nonferrous and fine metal sheets and strips to the point of fracture.

is the basis of workability of metal sheets for manufacturing purposes.

Test pieces of 3½ in. sq and sheets or strips up to 2 7/16 in. wide can be tested with standard tools. Additional interchangeable tools can be supplied for checking narrow strips up to 25/64, ¾ and 1 in. wide, for coin blanks, and to determine the deep drawing value of materials.

Metal-to-Metal Sealers Designed for Automotive Assembly Lines

Two new metal-to-metal sealers designed for assembly lines that use heat have been announced by the Adhesives and Coating Div., *Minnesota Mining and Manufacturing Co.*, 411 Piquette Ave., Detroit 2.

First introduced for automotive manufacturing, EC 1118 was used for sealing door hinges of autos, and EC 1104 was used to seal automobile rain gutters and the contour-break on auto bodies.

Under exposure to the heat normally encountered in paint drying ovens, the sealers cure to tough, leathery films resistant to most solvents and outdoor weathering. They are applied with a

New Materials and Equipment

flow gun to clean, dry and grease-free surfaces to insure proper adhesion. The method of application is briefly this:

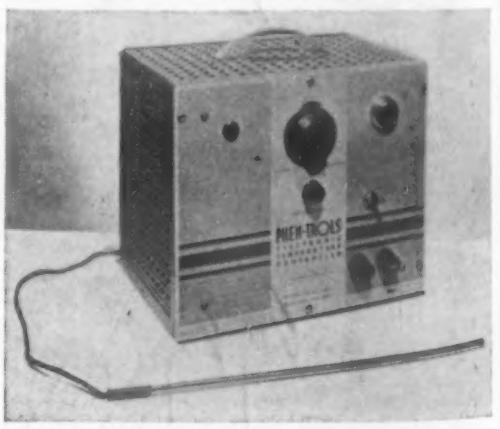
1. Prime or Bonderize metal and pass through drying oven.
2. Apply 3M Adhesive EC 826 to surface while still hot from oven.
3. Apply 3M Sealer EC 1104 with pressure flow gun.
4. Spray finish coat of paint.
5. Cure EC 1104 and dry paint simultaneously in oven.

Adhesive EC-826 is used as a primer where maximum adhesion is required.

Both sealers are 100% solids, with a synthetic resin base. EC 1104 is a cream-white with a viscosity of medium syrup, while EC 1118 is brown, with a viscosity of heavy paste. They are both non-shrinking, have good adhesion to metal, and do not sag at room or curing temperatures.

Electronic Temperature Controller Has High Sensitivity

A rugged, highly sensitive electronic temperature controller has been introduced for use in laboratories and industry with heated molds, immersion heaters, liquid baths, ovens, furnaces, laboratory heating jackets and similar devices where close



A stainless steel single thermocouple actuates this temperature controller when connected to a heating device.

control of critical temperatures over a long period of time is desired.

According to the manufacturer, *Phen-Trols, Inc.*, 15 Franklin Pl., Rutherford, N. J., the controller, a direct dial setting type, will maintain preselected temperature within 0.50 C sensitivity from any setting within its range. Designed to operate from standard outlet of 115-v, 60-cycle current fused to carry necessary load, it will handle loads up to 3,000-watt capacity.

The unit is positive and free from

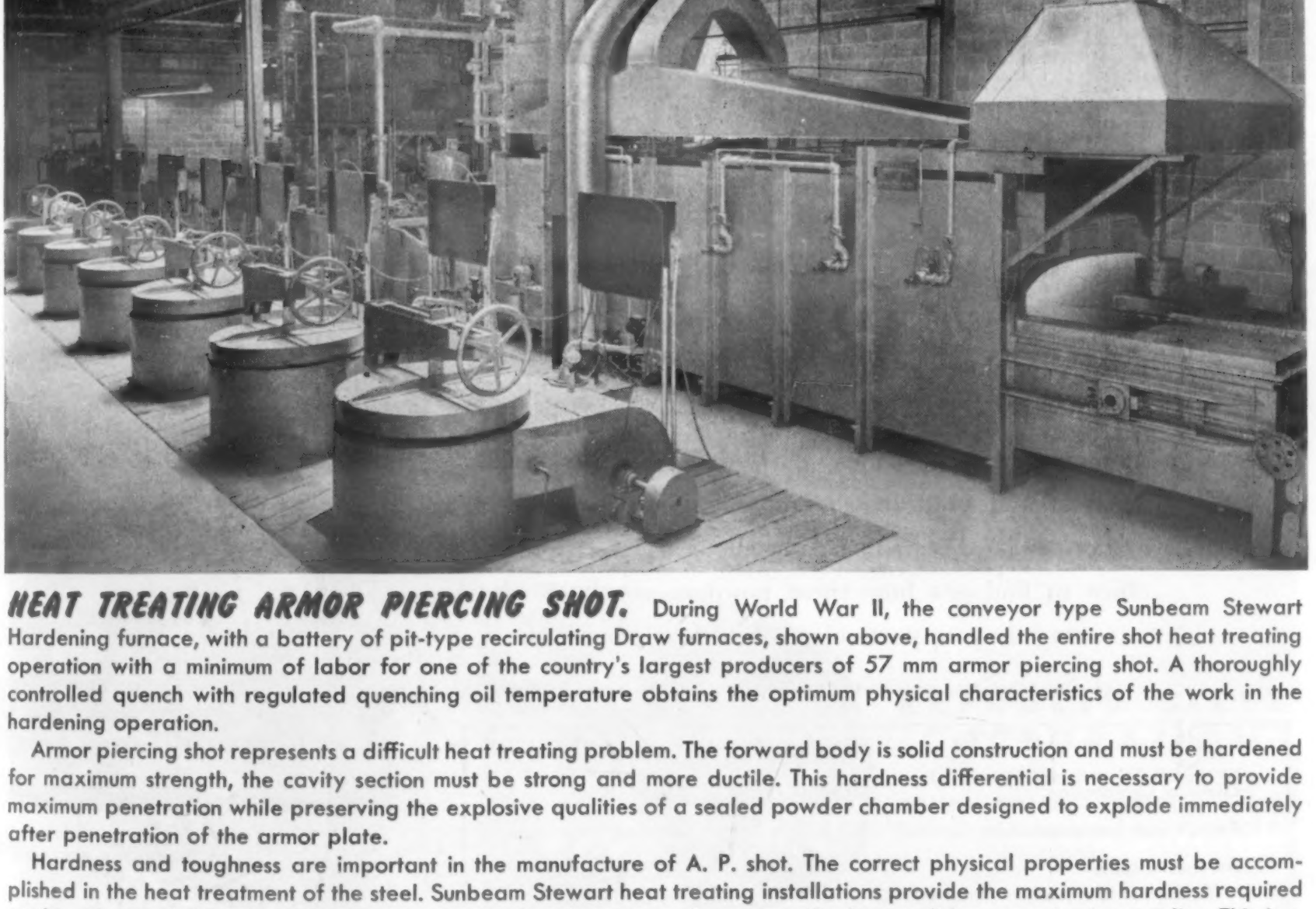
No. 109 of a Series of Typical Installations

Sunbeam STEWART

THE BEST INDUSTRIAL FURNACES MADE

HOW SUNBEAM STEWART FURNACES MEET THE DEMANDS ON THE PRODUCTION FRONT

DEFENSE REQUIREMENTS CAN BE MET QUICKLY WITH PROVEN SUNBEAM STEWART HEAT TREATING EQUIPMENT



HEAT TREATING ARMOR PIERCING SHOT. During World War II, the conveyor type Sunbeam Stewart Hardening furnace, with a battery of pit-type recirculating Draw furnaces, shown above, handled the entire shot heat treating operation with a minimum of labor for one of the country's largest producers of 57 mm armor piercing shot. A thoroughly controlled quench with regulated quenching oil temperature obtains the optimum physical characteristics of the work in the hardening operation.

Armor piercing shot represents a difficult heat treating problem. The forward body is solid construction and must be hardened for maximum strength, the cavity section must be strong and more ductile. This hardness differential is necessary to provide maximum penetration while preserving the explosive qualities of a sealed powder chamber designed to explode immediately after penetration of the armor plate.

Hardness and toughness are important in the manufacture of A. P. shot. The correct physical properties must be accomplished in the heat treatment of the steel. Sunbeam Stewart heat treating installations provide the maximum hardness required at the *point* and throughout the shot thus meeting ordnance requirements with clean, solid armor piercing quality. This is a result of even, thorough heating of the uniformly spaced and positioned shot, with continuous flush quenching at shot tip using controlled temperature quenching oil.

IF YOU ARE CONSIDERING DEFENSE WORK CALL SUNBEAM STEWART. Designs are available for heat treating the following materiel:

SHELLS: 57MM; 75MM; 90MM; 105MM; 120MM; 155MM; 3", 5", 6", 8" Navy Shells (Harden, Quench and Draw).

FORGINGS: Rotary Hearth and Pusher-type Forging Furnaces.

ARMOR PIERCING SHOT (Harden, Quench and Draw).

CARTRIDGE CASES (Anneal, Stress Relieve).

MACHINE GUN CLIPS (Harden, Quench and Draw).

JET AIRCRAFT and TANK PARTS

Sunbeam STEWART **INDUSTRIAL FURNACE DIVISION of Sunbeam CORPORATION**

(Formerly CHICAGO FLEXIBLE SHAFT CO.)

Main Office: Dept. 111, 4433 W. Ogden Ave., Chicago 23 — *New York Office:* 322 W. 48th St., New York 19 — *Detroit Office:* 3049 E. Grand Blvd., Detroit

Canada Factory: 321 Weston Rd., So., Toronto 9

A letter, wire or 'phone call will promptly bring you information and details on SUNBEAM STEWART furnaces, either units for which plans are now ready or units especially designed to meet your needs. Or, if you prefer, a SUNBEAM STEWART engineer will be glad to call and discuss your heat treating problems with you.

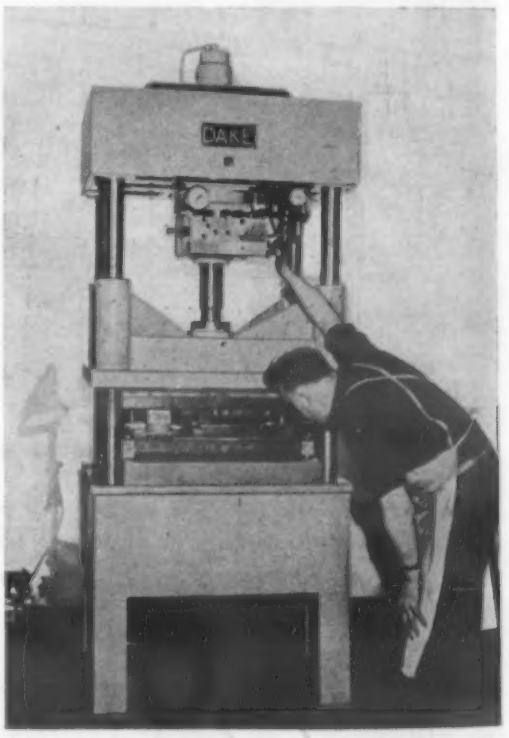
New Materials and Equipment

drift, double fused for full protection, and is "fail-safe" constructed in the event of failure of components or thermocouple. It is also equipped with twin plug-in receptacles for hook up of devices or to selonoid or other temperature controls.

Hydraulic Presses for Use in Die Matching

A new series of hydraulic presses has been designed for use in die matching, to avoid tying up production equipment, for short production runs, and for manufacturing samples.

According to the manufacturer, *Dake Engine Co.*, Grand Haven, Mich., the new



This hydraulic press can be used for die matching, for short production runs and for manufacturing samples.

line includes both single and double acting designs, in capacities ranging from 25 to 125 tons. All models are actuated by a simple hydraulic mechanism which is operated either by an electric motor, or by an air cylinder designed to attain maximum power and speed at 90- or 145-lb air pressure.

Porcelain Enamel Adherence Meter

A new instrument for accurate measurement of porcelain enamel's adherence to metal has been made available by the

Republic Metallurgical Service

helps leading bearing producer save 30% IN HEAT TREATMENT COSTS

When you can take a top-quality precision bearing, improve the quality still further—*and cut production costs in the process*—there's sure to be an interesting story involved.

In this case, it's the story of many months of close cooperation between the metallurgical staffs of a leading roller-bearing producer and Republic Steel. It's a story that may be summarized like this:

Having determined that no appreciable advantages could be obtained from a change in alloy steel analyses, Republic's Field Metallurgist recommended a change in heat treatment cycle. The change was made. After a thorough testing period, the following benefits were noted:

1. **Furnace time required for carburizing—substantially reduced.**
2. **Re-heat treat—almost completely eliminated.**
3. **Parts distortion resulting from heat treat—also reduced.**

As a result, overall heat treatment costs were reduced by approximately 30% . . . grinding time of carburized parts was effectively lessened . . . bearing quality was further improved.

Perhaps you, too, are using the *right* analysis of alloy steel, but could profit through more efficient processing of that steel.

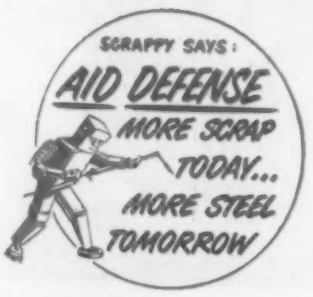
Republic—world's largest producer of alloy and stainless steels—offers you the *confidential* services of its 3-Dimensional Metallurgical Service without cost or obligation. Write, wire or phone.

REPUBLIC STEEL CORPORATION

Alloy Steel Division • Massillon, Ohio

GENERAL OFFICES • CLEVELAND 1, OHIO

Export Dept.: Chrysler Bldg., New York 17, N.Y.



Republic **ALLOY STEELS**

REPUBLIC STEEL

Other Republic Products Include Carbon and Stainless Steels—Sheets, Strip, Plates, Pipe, Bars, Wire, Pig Iron, Bolts and Nuts, Tubing

New Materials and Equipment

Porcelain Enamel Institute, 1010 Vermont Ave., N.W., Washington 5, D. C.

The result of more than four years of research, the new adherence meter evaluates adherence of porcelain enamel to steel by electrical contact, thereby eliminating the variable human factor involved in previous adherence testing methods. Since porcelain enamel normally is an electrical insulator, the basic principle of the meter depends upon the completion of an electric circuit through the metal of the deformed specimen to a steel probe touching the testing area. By using a large number of probes, and counting the number that conducts a current during testing, an accurate determination in terms of numerical units can be made of the area that has been exposed.

According to the Institute, the new unit is adaptable to metals from 13- to 24-gage thickness and can be used on many production parts as well as laboratory samples.

Carbon Determination Units

The need for fast and accurate carbon analysis in step with melting and processing is well recognized. Two carbon determination units that are designed to give fast and accurate carbon analysis have been announced by *Harry W. Dietert Co.,* 9330 Roselawn Ave., Detroit 4.

For irons and organics, the Carbon De-

This melters carbon test gage used when melting steel produces carbon content within two points a minute.

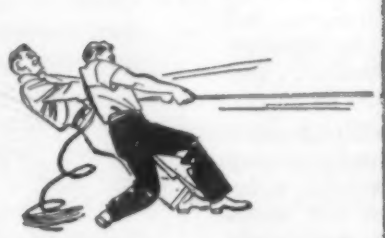
Here are the advantages of

CHASE PHOSPHOR BRONZES

HIGH STRENGTH

HIGH-FATIGUE RESISTANCE

GOOD DUCTILITY



GREAT RESILIENCY

EXCELLENT CORROSION RESISTANCE

CHASE PHOSPHOR BRONZES are hard working alloys that stand up under tough production assignments.

These tin-alloy bronzes are extremely versatile. You'll find one alloy suited for such functions as bearings, fuse clips, spring contacts and springs. Others will do a superior job in diaphragms, screw machine products, gears, spindles, valve parts and similar products.

Chase Phosphor Bronzes are made in Rod, Strip and Wire. Each is subject to the careful scrutiny of Chase metallurgists and engineers in order to maintain Chase standards for surface finish and the requisite internal characteristics.

Fill in and mail the coupon below for free folder giving further information about the properties of Chase Phosphor Bronzes.

FREE FOLDER—Mail the coupon for folder giving tables of properties (hardness, tensile, fabrication, physical) as well as uses and forms.

Chase BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

• *The Nation's Headquarters for Brass & Copper*

Albany†	Cleveland	Kansas City, Mo.	New York	San Francisco
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
Baltimore	Denver†	Milwaukee	Pittsburgh	Waterbury
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston†	Newark	Rochester†	(†sales office only)
Cincinnati	Indianapolis	New Orleans	St. Louis	

CHASE 75th ANNIVERSARY 1876 - 1951

Chase Brass & Copper Co., Dept. MM1051
Waterbury 20, Conn.

Please send me folder on Chase Phosphor Bronzes.

Name_____

Firm_____

Position_____

Address_____

City_____ State_____

New Materials and Equipment

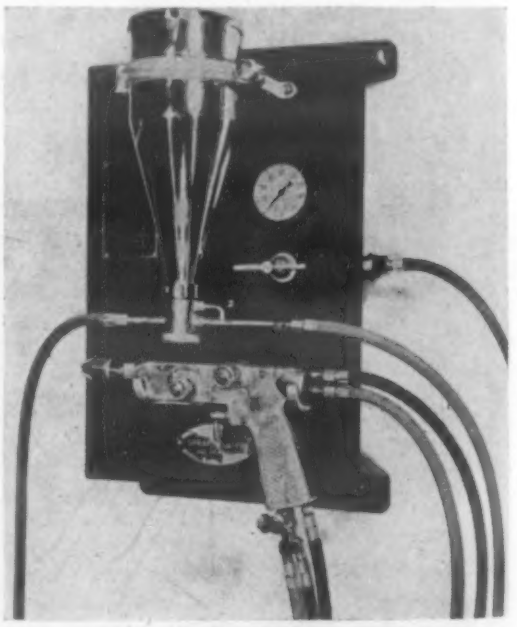
terminator, used with the Company's Varitemp furnace, is said to produce excellent results; while the Melters Carbon Test Gage, used when melting steel, is claimed to produce the carbon content within two points a minute.

Powder Metallizing Unit Applicable to Many Metals

Wall Colmonoy Corp., 19345 John R St., Detroit 3, has announced a new model of their Spraywelder, a powder metallizing unit. The process consists of applying uniform overlays of Colmonoy hard facing alloys using metallizing procedures and then subsequently bonding the overlay to the base metal.

In addition, the unit can be used to apply metal powder coatings such as copper, brass, stainless steel, aluminum and zinc.

According to the company, the Model B Spraywelder incorporates such new features as: (1) lighter weight, (2) eye level air gage, (3) greater capacity air filter, (4) air regulator at convenient



This powder metallizing unit can be used to apply metal powder castings such as copper, brass, stainless, aluminum and zinc.

height, (5) more positive air and powder control valves, (6) new trigger mechanism giving finger tip control with lock for continuous or intermittant spraying, (7) increased cooling chamber in head insures steadier operation and longer tip life, and (8) locked feed mechanism on carburetor eliminates possible change in powder feed setting.

Colloidal Graphite Serves as Lubricant in Hot and Cold Forming of Metal

by **ALDEN CRANKSHAW**, Acheson Colloids Corp.

● COLLOIDAL GRAPHITE, which is entirely distinct from ordinary powdered graphite, is of particular value in metalworking because of its extraordinary lubricating qualities and its pronounced resistance to heat.

Colloidal graphite is a solid lubricant, softer than talc, the tiny particles of which slip over one another with very little friction as a result of a peculiar arrangement of their atoms. It is available commercially as highly concentrated dispersions, which take the form of pastes or liquids. Colloidal graphite is dispersed in a variety of vehicles for ease of application as well as for other reasons dictated by circumstances.

The film formed by an application of colloidal graphite is usually microscopically thin and will not appreciably alter even what might be termed "critical dimensions". Graphite films are not subject to rupture except under conditions of heavy and prolonged abrasion and, being unaffected by heat (up to 5000 F in inert atmospheres), they are far more durable than are lubricating oil films.

The following paragraphs describe how colloidal graphite can be used to advantage in numerous metalworking operations.

Deep Drawing and Stretch Forming

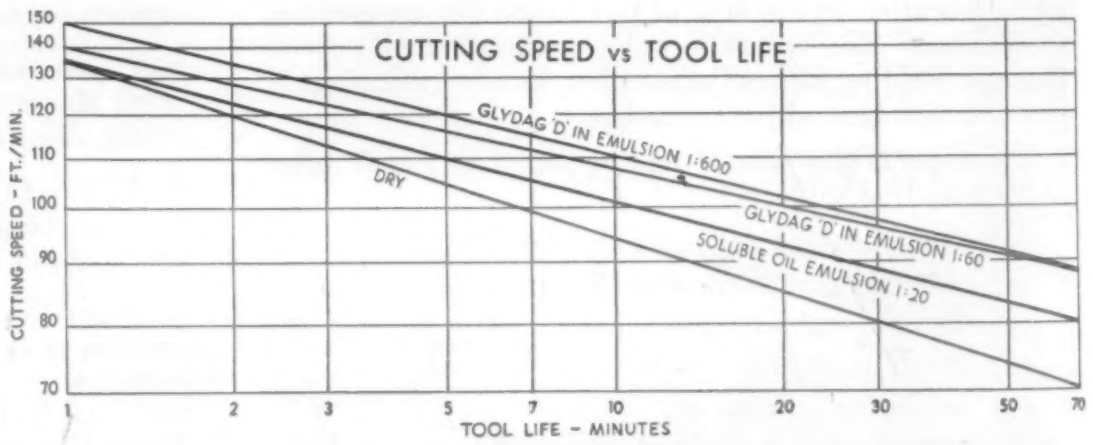
Magnesium, aluminum and other light metals are prone to tear and ripple in stretch forming and deep drawing. Also, magnesium sheets tend to seize on the die, causing the latter to become loaded with metal particles. Colloidal graphite applied by brush or spray to the dies, rings and forms used in this work eliminates such damage. Magnesium is particularly difficult to handle because, at the temperatures at which sheets are usually drawn or formed, they are semi-plastic and score easily unless protected. Colloidal graphite sprayed on both sheet stock and die gives the necessary protection. After drawing, the piece is best cleaned in a chromic acid bath to remove excess graphite.

Wire Drawing

When dies are lubricated with colloidal graphite their productive life is extended considerably. They form wire of uniform diameter, and wire breakage is minimized. Colloidal graphite is the only substance known which adheres to the wire at red heat and lubricates the die. Tungsten and molybdenum, which are notably hard to draw, are easily put through dies lubricated with colloidal graphite. Indeed, the first tungsten filament ever drawn was done with the help of Aquadag, an aqueous dispersion of colloidal graphite.

The metals are prepared for reduction by first passing through a colloidal graphite solution and then through a heating device before entering the drawing die. Dies used in the forming of steel wire can also

(Continued on page 182)

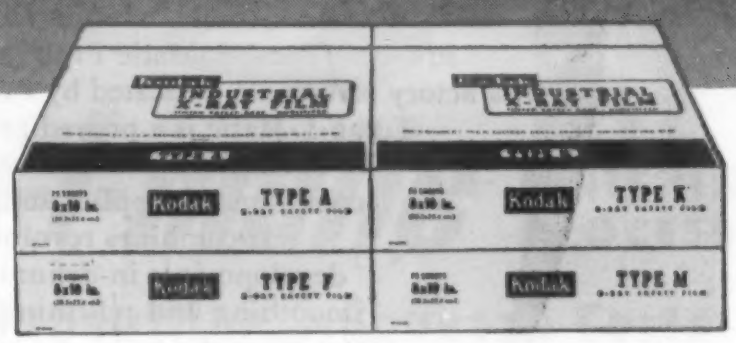


How lubrication with colloidal graphite increases cutting tool life.

What's the right X-Ray film?

Product:
Propane Gas Tank
Material:
1/4-inch thick
sheet steel
Purpose:
check bottom weld
Equipment:
120 kv X-ray machine

ANSWER:

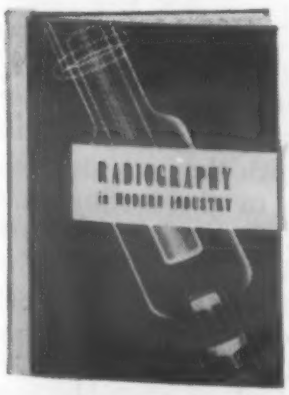


KODAK INDUSTRIAL X-RAY FILM, TYPE A

With several hundred of these tanks in use, subject to frequent handling as well as high pressure, safety demanded that the bottom weld be sound—that there be no serious lack of fusion or gas porosity.

To make these radiographs, the radiographer used Kodak Industrial X-ray Film, Type A; 120 kv; .005-inch lead screens, front and back.

Type A has enough speed to keep exposures reasonably short even at low voltages. Its high contrast and fine graininess are also valuable in taking full advantage of higher kilovoltage machines in detecting irregularities in thick or dense materials.



RADIOGRAPHY IN MODERN INDUSTRY

A wealth of invaluable data on radiographic principles, practice, and technics. Profusely illustrated with photographs, colorful drawings, diagrams, and charts. Get your copy from your local x-ray dealer—price, $3.

A TYPE OF FILM FOR EVERY PROBLEM

To provide the recording medium best suited to any combination of radiographic factors, Kodak produces four types of industrial x-ray film. These provide the means to check welds efficiently and thus extend the use of the welding process.

Type A—has high contrast with time-saving speed for study of light alloys at low voltage and for examining heavy parts at 1,000 kv. Used direct or with lead-foil screens.

Type M—provides maximum radiographic sensitivity, under direct exposure or with lead-foil screens. It has extra-fine grain and, though speed is less than in Type A, it is adequate for light alloys at average kilovoltage and for much million-volt work.

Type F—provides the highest available speed and contrast when exposed with calcium tungstate intensifying screens. Has wide latitude with either x-rays or gamma rays, exposed directly or with lead screens.

Type K—has medium contrast with high speed. Designed for gamma ray and x-ray work where highest possible speed is needed at available kilovoltage without use of calcium tungstate screens.

EASTMAN KODAK COMPANY
X-ray Division • Rochester 4, N. Y.

Radiography . . .

another important function of photography

Kodak
TRADE-MARK

Colloidal Graphite

continued from page 180

be advantageously lubricated with colloidal graphite. For this application a mixture of one part colloidal graphite dispersion and four parts of water is used. A half-pint of corn syrup to serve as a non-foaming wetting agent can be added to each gallon of solution. Steel wire or rods to be drawn are immersed in the graphite solution and dried in an oven heated to 200 F. This formula, applied in the foregoing manner, will coat 200,000 pass-pounds per 90-gal solution with no visible graphite on the finished wire.

Piercing, Extruding, Spinning

Piercers and dies produce smoother parts to closer tolerances when treated with colloidal graphite. Here, too, graphite treatment prevents damage to dies and, consequently, extends their life.

Piercers, punches and similar tools can be provided with a non-galling, self-lubricating surface by the application of a concentrated aqueous colloidal graphite dispersion diluted with 10 to 20 times its weight of water. This is a form of pre-treatment which is beneficial not only to the tools themselves, but which also reflects itself in the products made by them.

Extrusion dies making aluminum tubing and structural shapes need not suffer metal pick-up. When sprayed before each extrusion with a dispersion of colloidal graphite, the affinity between the die and the metal being worked is reduced.

When magnesium is being spun, both sides of the blank should be sprayed with a colloidal graphite dispersion to prevent scoring of the spinning tool. The graphoid film so produced reduces friction and minimizes the harmful effects resulting from contact with the tool. As with deep-drawn magnesium, excess graphite lubricant can be removed from the spun part in a chromic acid bath.

Casting

A basic problem of foundry practice is to separate castings from the molds in which they are made without damage to the casting or the mold. This difficulty is found in sand or permanent mold casting; in fact, in every process in which the clean separation of adjacent elements is a necessity. The condition is usually exaggerated by heat. Colloidal graphite reduces friction, improves parting,

Colloidal Graphite

continued from page 182

and affords protection against the harmful effects of heat.

Permanent molds, patterns, flask pins, shoulder screws, ladle interiors and chills can all be beneficially coated with colloidal graphite. Molds so treated give superior reproduction and smoother casting surfaces. Less finishing is required, and often none at all. Rejects are fewer and inspection takes less time. Mold life is lengthened.

Binding and stripping of flask pins is eliminated, an important saving in time and maintenance. Chills are easily removed without damage to the casting surface. Molten metal flows freely and completely from ladles without any adhesion to inside surfaces.

Application is made by brushing, spraying or dipping. The carrier evaporates immediately, leaving a microscopically thin uniform film of graphite. It is not detectable by any mechanical measuring devices, and, therefore, has no effect on dimensional tolerances of the mold or casting. Colloidal graphite is chemically inert and causes no undesirable reactions. It absorbs gases and, therefore, even in the small quantities present, tends to cut down the formation of gas-pockets. Finally, the water dispersions of colloidal graphite eliminate smoking, and thus to a great extent improve working conditions.

Other Applications

Die wear due to slippage at the outer edges of plates and at angles of the bend can be reduced by application of undiluted colloidal graphite dispersion.

A coating of colloidal graphite on all parts to be press-fitted greatly simplifies this operation. The graphite surface permits smooth, continuous pressing without danger of distortion. The dispersed solid lubricant is applied by brushing or spraying, and forms a tenacious fast-drying film.

It is possible to pre-lubricate screw threads and thereby prevent their seizure and stripping. First, parts should be thoroughly degreased (preferably with trichloroethylene) and heated to 250 F. Following this, a colloidal graphite solution is brushed or sprayed on the parts.

If the pieces are small, they can be treated in a bath, after having been heated to about 300 F. They should then be dipped in the mixture several times while they still retain enough heat to evaporate the carrier.

News Digest

Hot Hardness Tester

continued from page 13

slightly above atmospheric pressure and by making the indenter shaft a capillary of fused silica which moves in a dry bearing lubricated with graphite. Clearance between shaft and bearing is only about 0.001 in. and the gas escapes slowly through this space during the test.

The NBS apparatus consists essentially of a Vickers diamond indenter mounted on the shaft of fused silica; a mechanical device for raising and lowering the indenter; an electric furnace for heating the specimen; and a micrometer device for orienting the specimen under the indenter. Loading mechanism indenter and furnace are all enclosed in one compact, self-contained unit.

The muffle was constructed by welding heavy-watted stainless-steel pipes together and is heated with Nichrome wire wound on an Alundum form. The anvil is a solid piece of stainless steel welded into the vertical pipe; a small hole extends to within 0.125 in. of its upper surface to accommodate a thermocouple. The space between the furnace unit and the outer shell of the apparatus is filled with insulation. By making the muffle assembly a single welded unit and by supporting it from a single point, relative motion between various parts due to thermal expansion is minimized.

Because the indenter fitting cannot be anchored directly to the fused silica, it is first attached to a tungsten rod, which passes up through the silica capillary and is held by a collar and set screw. A spring at the top of the rod holds it under continuous tension and thus allows for its expansion with increasing temperature.

The indenter and its shaft are raised and lowered at the rate of 2 cm (0.75 in.) per min by a small motor which operates a simple screw mechanism similar to that used on the compound rest of a lathe. The vibration of the motor is damped by a mounting of rubber shock absorbers.

The indenter assembly weighs about 200 g. Additional load can be applied to the indenter by placing weights on top of the assembly. Lower loads for use at elevated tem-

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News Digest

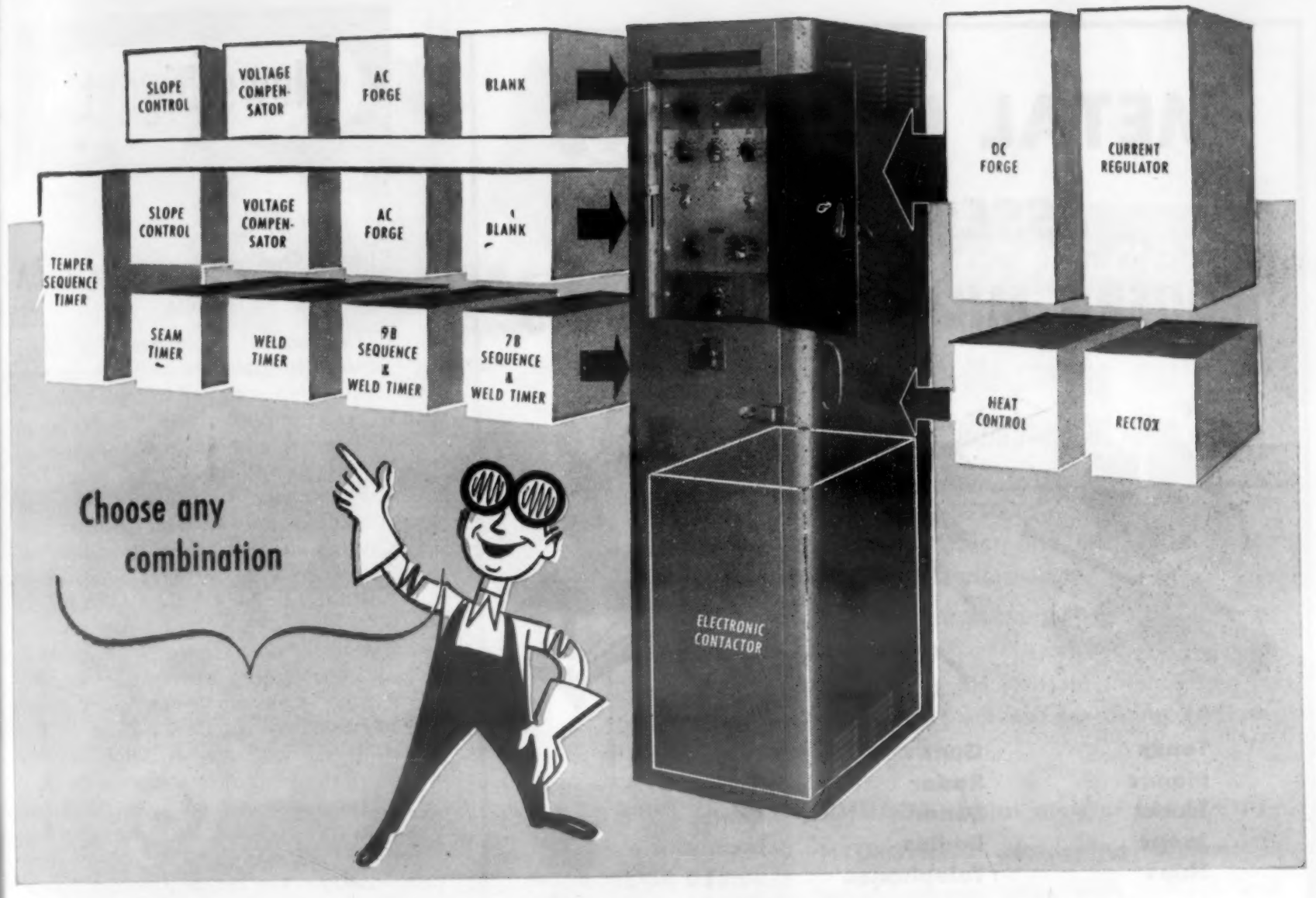
peratures are obtained by increasing the gas pressure in the tester above atmospheric.

The six specimens to be indented in one heat fit into a tray or carriage which slides on a keyway on the inside of the muffle tube. The carriage is moved along the tube by a stainless-steel micrometer screw which is plated with cobalt-tungsten alloy to prevent seizing at elevated temperatures. The micrometer serves to locate an indentation within about 0.2 mm (0.008 in.) of a desired spot.

Because the indentations are microscopic in size, they are difficult to locate in the small field of a microscope for measurement of their dimensions. For this reason, a fitting has been designed to hold the carriage in a definite position on the stage of a travelling microscope. By setting the microscope stage at the same reading as that on the micrometer when the indentation was made, the impression is easily brought into the field of view

In addition to its use in measuring the hot-hardness of electrodeposits, the NBS Microhardness Tester has several advantages which should make it useful in the testing of bulk metals. For example, when measurements are made at high temperatures, the small loads which are applied to the indenter are less likely to cause the diamond to shift in its mounting than are the larger loads usually applied in hot-hardness testers of this type. The micrometer screws, which permits indentations to be made at specified points and enables them subsequently to be located in the microscopic field, should also be advantageous in the testing of bulk metals as well as electrodeposits.

Lack of a suitable apparatus for comparison has made it impracticable to determine the accuracy of the NBS Microhardness Tester at high temperatures. However, when it was compared at room temperature with a standard type of microhardness tester using a variety of different kinds of specimens, the agreement was within 4% on the average. Reproducibility has been determined by measurements on a molybdenum specimen: in four runs, at room temperature, 752, 1112 and 1472 F, the average deviation from the mean hardness at each temperature was less than 4%.



KEEP YOUR WELDING CONTROLS OUT OF MOTH BALLS

Interchange these components to match production changes

Now you can keep your resistance welding control "on the line", regardless of production changes. With a Westinghouse Welding Control you merely add or substitute the necessary control components.

The Westinghouse Welding Control is built up of basic control components and auxiliary control units. Basic controls include the electronic contactor and sequence and weld timer, synchronous or nonsynchronous. Auxiliary controls include a wide range of functional units among which are: forge timer, slope control, voltage compensator and dual weld attachment. Combinations of the complete line of components can be assembled to meet the needs of practically all resistance welding techniques. All component units plug in to either a 600 or 1200-frame electronic contactor structure.

Each unit is self-contained and completely prewired at the factory. Mount the panel and insert the polarized plug—that's all it takes to make a complete change-over.

Many other advancements in control design such as the transformer-type flow switch, are built into this packaged control for resistance welding. Get the complete story from your Westinghouse representative or write for Booklet B-4309. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-27006

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RESISTANCE WELDING CONTROL

News Digest

Stress Studies Covered in NACA Papers

Two sets of experiments of interest to materials engineers were described in paper-bound volumes recently published by the National Advisory Committee for Aeronautics, Washington, D. C.

Photoelastic investigation of stress concentrations due to small fillets and grooves in tension is described by M. M. Frocht, of the Illinois Institute of Technology, in Technical Note 2442. Factors of stress concentration for deep, sharp and symmetrically arranged grooves and fillets in tension members were determined. Curves show the distribution of the principal stresses on the section through the grooves. Complete isopachic patterns for several basic cases of grooved bars are also included.

Arthur G. Holms, of the Lewis Flight Propulsion Laboratory, describes a biharmonic relaxation method for calculating thermal stress in cooled irregular cylinders in Technical Note 2434. A numerical method was developed for calculating thermal stresses in irregular cylinders cooled by one or more internal passages. The use of relaxation methods and elementary methods of finite differences was found to give approximations to the correct values when compared with previously known solutions for concentric circular cylinders possessing symmetrical and asymmetrical temperature distributions.

New Corrosion Detection Method Discussed by Electrochemical Society

A revolutionary new method of detecting the presence of corrosion before it damages industrial and other installations was among the important advancements in electrochemistry announced at the semi-annual meeting of The Electrochemical Society, Inc., at the Hotel Statler in Detroit, Oct. 9-12. The new process, called "Rotogenerative Detection", is based upon the use of elec-

News Digest

trical currents to determine incipient weaknesses in the metal and future points of corrosion so that preventive measures can be taken.

The developers of the process, J. B. McAndrew, W. A. Colner and H. T. Francis, of the Armour Research Foundation, outlined its benefits during the two-day discussions conducted by the Society's Corrosion Div. Other major topics included a discussion of the corrosion of aluminum and its prevention by H. H. Uhlig and his associates of the Massachusetts Institute of Technology Corrosion Laboratory.

Other speakers at the two-day session (which offered over 20 papers) were Dr. Mars. Fontana, Ohio State; Dr. M. E. Straumanis, Missouri College of Mines; and Dr. Andrew Dravnieks of Standard Oil. Chairman of the Society's Corrosion Div. is Dr. Norman Hackerman, of the University of Texas.

Over 500 physicists, chemists, electrochemists and other scientists attended the Society's four-day convention.

Army Develops Stainless Steel Mobile Shower Bath for Korea

Engineers in the Army Quartermaster Corps believe that the boiler in their new mobile shower unit for front-line troops can heat hot water faster than any unit of its weight and size in the world. This boiler, made of stainless steel, is part of a self-contained two-wheel trailer unit that is compact and light enough to be towed by a jeep. Soldiers in Korea have been getting hot showers in water that is warmed to a comfortable temperature and specially heat treated for their health and safety.

Washing water around battle areas, even when it looks clean and pure, is likely to be loaded with bacteria. Polluted water carries a constant menace of diseases like typhus. Furthermore, in many tropical countries, parasites inhabit water supplies, ready to enter the body through any superficial cut or wound. Heat treatment renders such micro-organisms and bacteria harmless.

Here is how the mobile shower unit works. The trailer is parked by any

WALES SHEET METAL FABRICATOR provides rapid interchangeability for punching and notching. Work from blue prints or operation sheets. *No Templets Required.* Write for Catalog 10-A.

WALES DRILLING MACHINE is specially designed to meet the exacting requirements of locating, drilling and reaming holes in material of practically any length and up to 36" wide. Write for Catalog DM.

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To fully determine which Wales Equipment is most applicable to a particular type of work, call on Wales Engineers who have years of experience in the most economical way to fabricate sheet metal parts. Yes, make it standard practice to call on Wales Engineers FIRST for their valuable suggestions.

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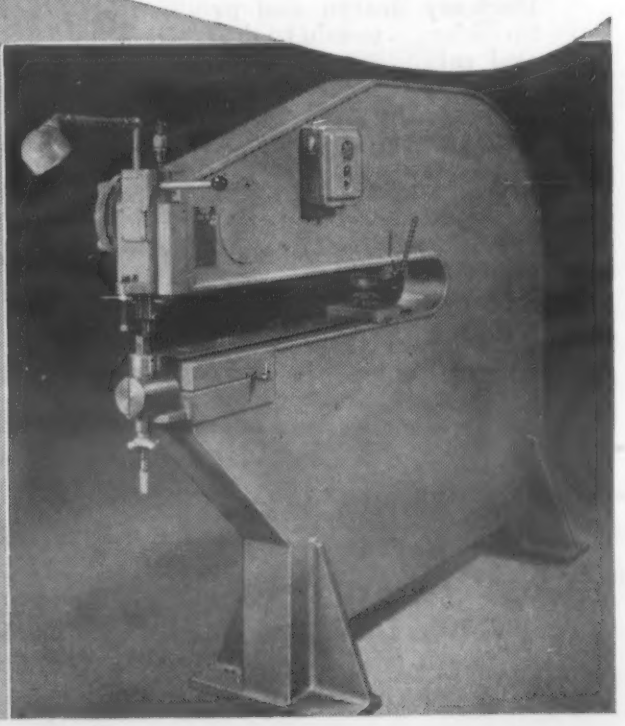
Specialists in Punching and Notching Equipment

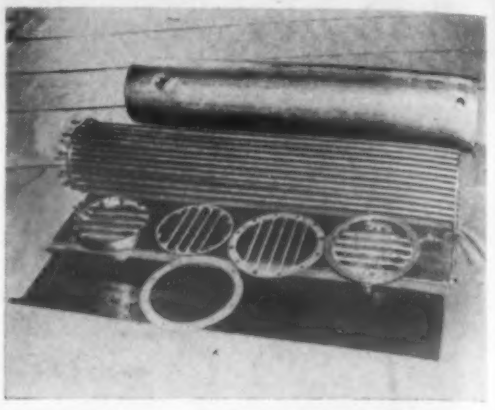
WALES TWIN COLUMN PRESS features simplicity of design that fulfills the engineering axiom "building it simple builds it better". In many cases, this press eliminates the necessity of a die set. Write for Catalog TC.



TRU-EDGE CONTOUR SHEAR cuts and trims irregular shapes and circles and also beads, rigidizes, forms and flanges. Ideal for accurate, short run work eliminating prohibitive die costs. *Send for Catalog TS.*

News Digest

convenient pond or stream. The operators hook up a flexible suction hose and throw its end into the water. Another flexible hose goes to a level, well-drained spot near-by where the shower pipe sections are erected. A gasoline engine in the trailer unit is then started up and the burners in the stainless steel boiler are lighted. Within 20 min hot baths are ready and running—and part of this time is



Near-boiling purified water is cooled for the showers by untreated water in two stainless steel heat exchangers.

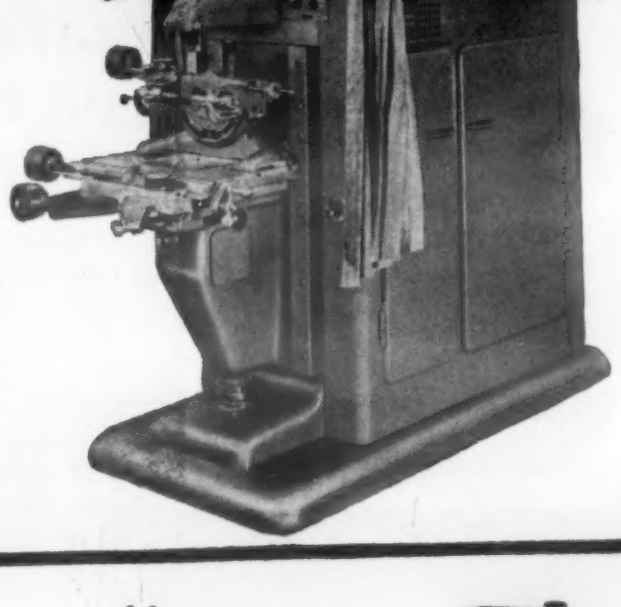
spent running scalding water through the showers and the system.

The boiler is about 7 ft long and a little over 2 ft in dia. Its burners can handle any liquid fuel from No. 4 burner oil to 100-octane gasoline. As much as 2½ million Btu per hr can be put into the water. This would heat 25 ordinary homes in mid-winter.

Water is heated in the stainless steel boiler to a few degrees below boiling and held there for about 20 sec. During that time, dangerous organisms in the water are killed or rendered harmless. After heat treatment, part of the hot water is cooled by incoming raw water in two stainless steel heat exchangers. Each heat changer is a boiler-like vessel with 250 stainless steel tubes, ½ in in dia by 6 ft long. Hot water flows back and forth through these tubes while cool water surrounding them soaks up heat. While it cools the treated water, the raw water gets warm, and it is then fed into the boiler with a good start up the temperature scale. An automatic mixing valve blends water from the boiler and cooler water from the heat exchangers. It takes just the right amount of each to regulate output at 102½ F—the perfect temperature for a shower bath. Whether the suction hose is in a tepid 80-deg pond or among broken ice cakes in a frigid river, the shower water always comes

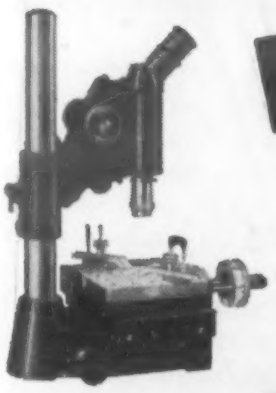
FOUR OPTICAL AIDS to help you SAVE MATERIAL and MAN-HOURS!

1 CONTOUR MEASURING PROJECTOR



You save time and money by assuring *more accurate measurements than any other projector can give you.* You get angular measurements to ±1 minute of arc, with the protractor screen. You get direct linear measurements to ± .0001″ over a range of 4″x6″, with the cross slide stage.

You save time and money by spotting inaccuracies quickly and simply. Dimensions, angles, and profiles of production-run parts can be compared directly with a *traced outline* of the projected image of the master part, or with a large scale drawing superimposed on the screen. Catalog D-27.



2 TOOLMAKERS' MICROSCOPE

Linear measurements to ±.0001″, and, when fitted with a protractor eyepiece, angular measurements to ± 1 minute of arc, can be made with this sturdy microscope. Operation is extremely *simple* and *fast.* Opaque and transparent objects of any contour can be measured. *Catalog* D-22.

3 STEREOSCOPIC WIDE FIELD MICROSCOPES

Provide clear, sharp, 3-dimensional, unreversed, magnified images. Used extensively in industry for greater speed and accuracy in small parts assembly operations, inspection of tools and finished parts, and precision machining of small parts. 15 models for many uses. *Catalog* D-15.

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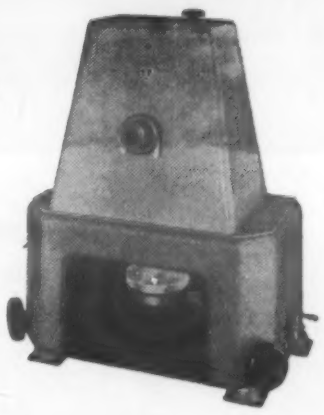

Now you can have "laboratory" accuracy of 0.000001″ in the determination of flatness and parallelism of reflecting surfaces . . . with production-line *simplicity* and *speed.* So simple that an unskilled operator can make measurements after a few minutes of instruction.

Two sizes of Para-Plane Gages are available: the larger (top) tests objects up to 6″ in diameter; the smaller (bottom) tests up to 3″ in diameter. *Bulletin* D-224.

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News Digest

out at the ideal, comfortable temperature—automatically.

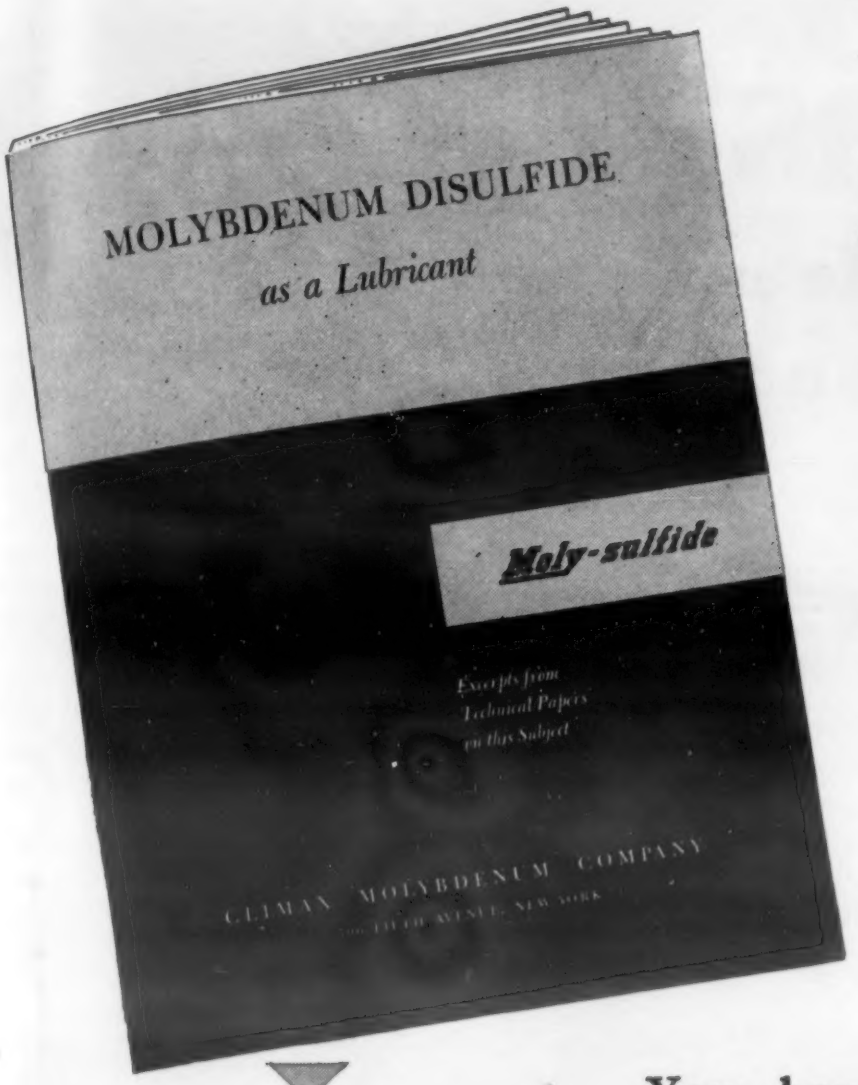
Designing a mobile shower unit with such a large heating capacity, rugged enough for field service, with automatic controls, and small and compact enough for a jeep-drawn trailer is a major triumph of engineering, according to the Army. The trailer, frame and cover, many of the structural parts, and the shower pipes are aluminum. Individual axle units with articulated parallel linkages and individual torsion springs are steel—as is the towing lunette, or eye. The water blender and the showerheads are made of brass. Each showerhead nozzle has a movable pin in its orifice. If it gets clogged, the soldier pokes the pin a few times.

Using stainless steel for the boiler and heat exchangers was not in the original plans. Quartermaster Corps engineers were under orders to use no stainless steel, as the Army claims to be well aware of the need for conservation. In all purchases, the Army makes strenuous efforts to avoid the use of critical materials—wherever possible.

Nevertheless, a tremendous heating and heat-transfer capacity had to be packed into a very small unit. Parts had to be small—so small that mechanical cleaning was impractical. Operating with all kinds of water — hard, soft, muddy or swampy—problems of cleaning and de-scaling were bound to arise. With stainless steel, these problems are solved by flushing out the tubes with 20% nitric acid, a treatment that would corrode most other metals. The service life of the unit is estimated at 1,000 operating hours. The next best boiler and heat exchanger material would have yielded only 250 operating hours. Consequently, stainless steel was selected — despite the policy of avoiding it. The only alternative was to build and ship overseas four times as many units as would be needed in stainless.

Nickel Supplies Seen Growing in the Near Future

Increased supplies of nickel within the next year or more are assured from at least three sources, O. B. J.



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* Molybdenum disulfide

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Fraser, metallurgical engineer, declared in opening the symposium on the developments in nickel at the diamond jubilee meeting of the American Chemical Society in New York.

Mr. Fraser said The International Nickel Co. of Canada, Ltd., largest producer, has increased its capacity by 5% in the current year and the second largest producer also has stepped up output substantially, while a third Canadian nickel producer will be operating within two to three years. In addition, he predicted that in the near future there will be sizable nickel production from Cuba.

Mr. Fraser, who is assistant manager of the development and research division of International, pointed out that 1951 is the 200th anniversary of the first isolation and recognition of nickel as a chemical element. Cronstedt, a Swedish scientist, accomplished the identification and published the results of his work in 1751.

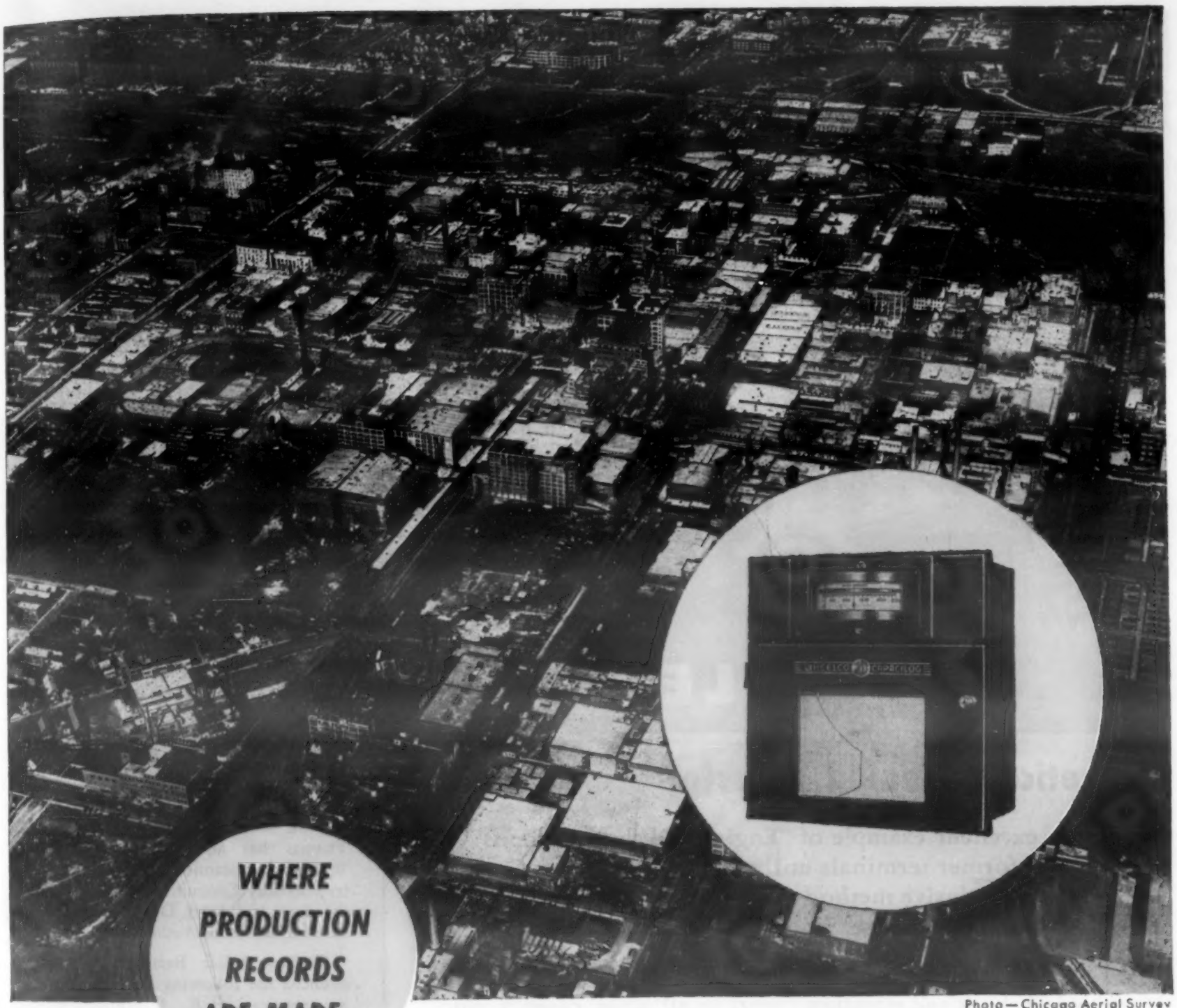
Nickel, Mr. Fraser observed, is distributed widely in nature but only in a few localities is nickel mineralization sufficiently concentrated to constitute ore bodies. Scientists, he said, have estimated that there is about twice as much nickel in the earth's crust as there is copper, zinc and lead combined. More than 60 nickel minerals are recorded in modern literature but only four of them have commercial importance.

News of Engineers

A. W. Winston, formerly executive assistant, has been named assistant manager of the Magnesium Dept. of the Dow Chemical Co., according to a recent company release. In his new position, Mr. Winston will have special responsibilities in business analysis, pricing, marketing and sales.

American Steel & Wire Co. has announced the appointment of *Orville L. Longbrake* as defense regulation engineer. In his new post in the General Engineering Dept., Mr. Longbrake will analyze and interpret government orders and regulations affecting engineering and maintenance operations in the company's 14 plants.

Horizens Inc. has recently announced



Photo—Chicago Aerial Survey

the wheelco recorder

Here's the Central Manufacturing District of Chicago—where more than 360 industries, concentrated in less than 1½ square miles, manufacture thousands of different products. Yes—here where production records are made and kept—the Wheelco Capacilog is invaluable for measuring, indicating, controlling and recording electrically measurable variables.

Specify the Wheelco Capacilog, a deflection type strip chart recorder that gives you accuracy to ¼ of 1% of total scale—suppressed scales with a built in reference point—Thermocouple Break Protection that completely eliminates "residual error". Capacilogs are built for use with thermocouples and resistance thermometer measuring elements; as single or multipoint recorders, and with six different control combinations including pneumatic and electric proportioning types.

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instrumentality When you specify Wheelco you specify *Instrumentality*—Wheelco's ability to design and build efficient and economical instruments to fulfill your needs for accurate and dependable control and recording.

Visit the Wheelco Booth #D-219, National Metal Exposition and Congress, Detroit, Mich., Oct. 15-19.

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wheelco *electronic controls*

News Digest

the addition of the following persons to its Cleveland Laboratories: *Eugene Bucur,* as a member of the Metallurgical Dept.; *Meyer L. Freedman,* as a member of the research staff; *Bertram C. Raynes,* as a research chemist; and *Marie Rose,* as a member of the Physics Dept.

The following appointments have been announced by Norton Co.: *Charles A. Bonn* has been named abrasive grain engineer; and *Everett M. Hicks,* manager, Norton's Grinding Machine Div., has been appointed a member of the Industry Advisory Committee of the Office of Price Stabilization.

Allis-Chalmers Manufacturing Co. has announced the following executive changes at its Boston Works: The appointment of *Leonard J. Linde* as assistant general manager and chief engineer; *Henry P. Pinkham* as assistant chief engineer; *John F. Chipman* as product engineer; *George W. O'Keeffe* as manager of sales; and *Chester D. Ainsworth* as standard engineer.

William J. Thomas, general sales manager of The Babcock & Wilcox Tube Co., has been named to the Tubing Industry Advisory Committee which functions under the Office of Price Stabilization. Mr. Thomas has also been named to the Welded and Seamless Steel Tubing Industry Advisory Committee functioning under the Iron and Steel Division of the National Production Authority.

Timken Roller Bearing Co. has announced the following promotions within its organization: *R. A. Schimpf* to chief works engineer; *H. J. Urbach* as executive engineer; *C. M. Maratta* as chief consulting engineer; and *L. A. Holder* to chief mechanical engineer.

The appointment of *William M. Stoll* as mining engineer has been announced by Kennametal, Inc. Mr. Stoll's duties will consist of locating and procuring minerals that constitute basic materials essential for the production of cemented carbides used in tools for metal-working and mining.

Speer Carbon Co. and its subsidiary, the International Graphite & Electrode Corp., have announced the appointment of Dr. *George J. Goepfert* as director of research for both companies. Prior to his present position, Dr. Goepfert was supervising engineer of the Organic Chemical Laboratory of the Research and Development Div. of the Carborundum Co.

John C. Wallace, formerly special projects development engineer with Baldwin-Lima-Hamilton Corp., has been appointed chief engineer for the newly created Diesel Engine Parts Research and Development Div. of Hunt-Spiller Manufacturing Corp.

Dynakon Corp. has recently announced the appointment of new officers: president,

When full productive capacity is a *"MUST"*

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STEEL INDUSTRY

MICARTA toughness improves steel production. It is found in roll-neck bearings, run-out tables, pickling lines, hold-down rolls, punch rolls, and insulators. This workable plastic is solving problems in all industries. Have you got a place for it?

Look to MICARTA® for help in getting and keeping full production. In working longer and better in vital machinery it helps keep things going at top speed. It is a basic material which does many jobs more efficiently than metal.

MICARTA is lighter than aluminum . . . and pound for pound, has a compressive strength greater than structural steel. It cannot rust.

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Explore this solid and workable plastic. It can be machined, formed, or fabricated easier and more economically than metal. Westinghouse Electric Corporation, Micarta Div., Trafford, Pa.

J-06443

News Digest

Harry Raech, Jr., a registered professional engineer with broad experience in the chemical, mechanical and electronic fields; and vice president, *Frank Griffen*.

Announcement has been made of the appointment of *R. C. Bennett, Jr.*, vice president of National Electric Products Corp., as a member of the industry advisory committee which will advise the Office of Price Stabilization on price regulations affecting the low voltage electrical distribution equipment industry.

John L. Heinlein has been appointed manager of manufacturing for the Central Div. of Continental Can Co., according to a recent company release.

John M. Martin has been named assistant general manager of the Explosives Dept. of Hercules Powder Co. For the past four years, Mr. Martin has served as assistant general manager of the company's Cellulose Products Dept.

Herman H. Miller, manager of the Compressor Div. of Worthington Pump and Machinery Corp., has relinquished the management of his division to act as consultant to his successor, *E. A. Murray*. Mr. Miller, who has served the company for 50 years, plans to retire at the end of this year.

Horizons Inc. has announced the appointment of Dr. *Sidney Doree Black* as division supervisor in Experimental Physics. Dr. Black has for four years been associate professor of aeronautical engineering at the Case Institute of Technology.

William M. Hawkins, American Car and Foundry Co. laboratory director at Berwick, has been named senior research engineer at New York in the Research and Development Dept. *George Reed*, manager of inspection, succeeds Mr. Hawkins at Berwick with the new title of manager, general laboratories.

Frank E. Watts, Jr. has been appointed assistant metallurgist for Hunt-Spiller Manufacturing Corp.

Dr. *C. J. Breitwieser* has been named executive assistant to Dr. F. R. Hensel, vice president in charge of engineering, at P. R. Mallory & Co., Inc. Dr. Breitwieser came to Indianapolis from California, where he was chief of electronics and head of the engineering laboratories at Consolidated Vultee Aircraft Corp.

Appointment of *Charles L. Campbell* as chief engineer of the Centrifix Corp. has been announced by the company. A veteran of 31 years in the chemical engineering fields, Mr. Campbell will direct design development of the company's line of purifying equipment.

The Bellows Co. has announced the election of *Herbert B. Link* as president of

(Continued on page 204)

NEED DEPENDABLE ALTERNATE MATERIAL including QUICK TOOL-UP and DELIVERY?

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Amplex type tools are, by comparison, inexpensive. Tool and die making facilities are available.

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Field Engineers and Depots throughout U.S. and Canada*

News Digest

the organization. Mr. Link succeeds *L. F. R. Bellows,* who died last May. *L. F. R. Bellows, Jr.,* has been named vice president.

Arthur D. Little, Inc. has announced the addition to its staff of *John Fletcher,* specialist in the field of varnishes, synthetic resins and protective coatings.

The appointment of Dr. *Clarence Zener* as an associate director of the Westinghouse Research Laboratories has been announced by the company. Formerly professor in the Institute of Metals and the Dept. of Physics at the University of Chicago, Dr. Zener will also serve as acting manager of the Solid State Physics and Magnetic Dept. of the Research Laboratories.

George V. Luerssen, formerly chief metallurgist, was appointed vice president in charge of metallurgy by the board of directors of The Carpenter Steel Co. Mr. Luerssen succeeds *B. H. DeLong,* who announced his retirement as vice president and technical director after 41 years of service. Other advancements announced were those of Dr. *Carl B. Post,* who succeeds Mr. Luerssen, and *George E. Brumbach* who advances to the position of metallurgist to succeed Mr. Post.

Andrew J. McCoy has been named assistant to *D. W. Watters,* production manager, magnesium wrought products, Madison Div., Dow Chemical Co. Prior to coming to Dow, Mr. McCoy was assistant to the superintendent of the Experimental Dept., Emerson Electric Co.

DeLaval Steam Turbine Co. has announced the following executive promotions: *James P. Stewart,* president; *Wencel A. Neumann, Jr.,* vice president of industrial sales; *H. G. Bauer,* vice president of engineering; *Charles A. Jurgensen,* vice president of manufacturing.

Election of *I. Melville Stein* to the newly created post of executive vice president has been announced by the directors of the Leeds & Northrup Co. Mr. Stein has been a vice president and is director of research.

Lawrence L. Garber, general manager, American-Fort Pitt Spring Div., H. K. Porter Co., Inc., has been elected a vice president of the company.

Appointment of *C. R. Horton, Jr.* as manager of the Engineering Development Dept. of Dravo Corp.'s Engineering Works Div. has been announced by the corporation. Mr. Horton has been with Dravo in various engineering and production capacities since 1936.

Marshall L. Havey, having reached retirement age, has resigned as executive vice president of The New Jersey Zinc Co. Mr. Havey will continue with the company on a part time basis, on special assignment as assistant to the president.

SAFTIFILTER*, all-plastic blood and plasma infusion set made by Cutter Laboratories, Berkeley, Calif.

the important Barrel is ... MADE OF

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heat resistance

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moisture resistance

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dimensional stability

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moldability

Styron (Dow polystyrene) here serves dramatically in the hospital field. A deep draw over a precisely dimensioned core dictated Styron for the barrel of this blood and plasma infusion set. Styron has the moldability and dimensional stability so necessary to fabricate precision components. Uniform quality and maintenance of precise dimensions in service were assured by annealing the barrel made of Styron.

In the manufacture of this essential product, and many others, the range of Styron's properties offers engineers and designers the advantages of more design freedom, quality product appearance and reduction in assembly steps and production costs—all of significance to manufacturing industries.

Dow offers a complete line of quality-controlled polystyrene plastics under the trade-mark name Styron. Dow's Plastics Technical Service is fully equipped to advise you on the applicability of Styron to *your* manufacturing operations. Write today.

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The Styron label is the hallmark of quality in plastics goods.

DOW plastics

STYRON brand plastics

... basic raw materials serving basic industries

News Digest

Arthur J. Williamson has been appointed vice president in charge of manufacturing operations by Tube Reducing Corp. For 13 years, prior to his appointment, he was with Summerill Tubing Co. and served both as plant manager and chief metallurgist.

Robert M. Lundgren has been appointed vice president of The Kuljian Corp. For the past five years Mr. Lundgren has been closely associated with new engineering and construction projects. In his new capacity he will have charge of the sales program of the company.

At a recent directors meeting of Superior Steel Corp., *Eugene J. Reardon,* vice president, was elected executive vice president. Mr. Reardon was formerly chief engineer of American Steel & Wire Co.

Air Reduction Co., Inc., has announced the appointment of *S. B. Baumer* as vice president of the Airco Equipment Manufacturing Div. Prior to his appointment, Mr. Baumer was manager of the General Technical Sales Dept.

The board of directors of The Riverside Metal Co., has announced two promotions: *John Gribbel, 2nd,* formerly secretary, has been appointed vice president, assistant to the president; and *Leslie G. Carter,* formerly treasurer, has been appointed secretary-treasurer.

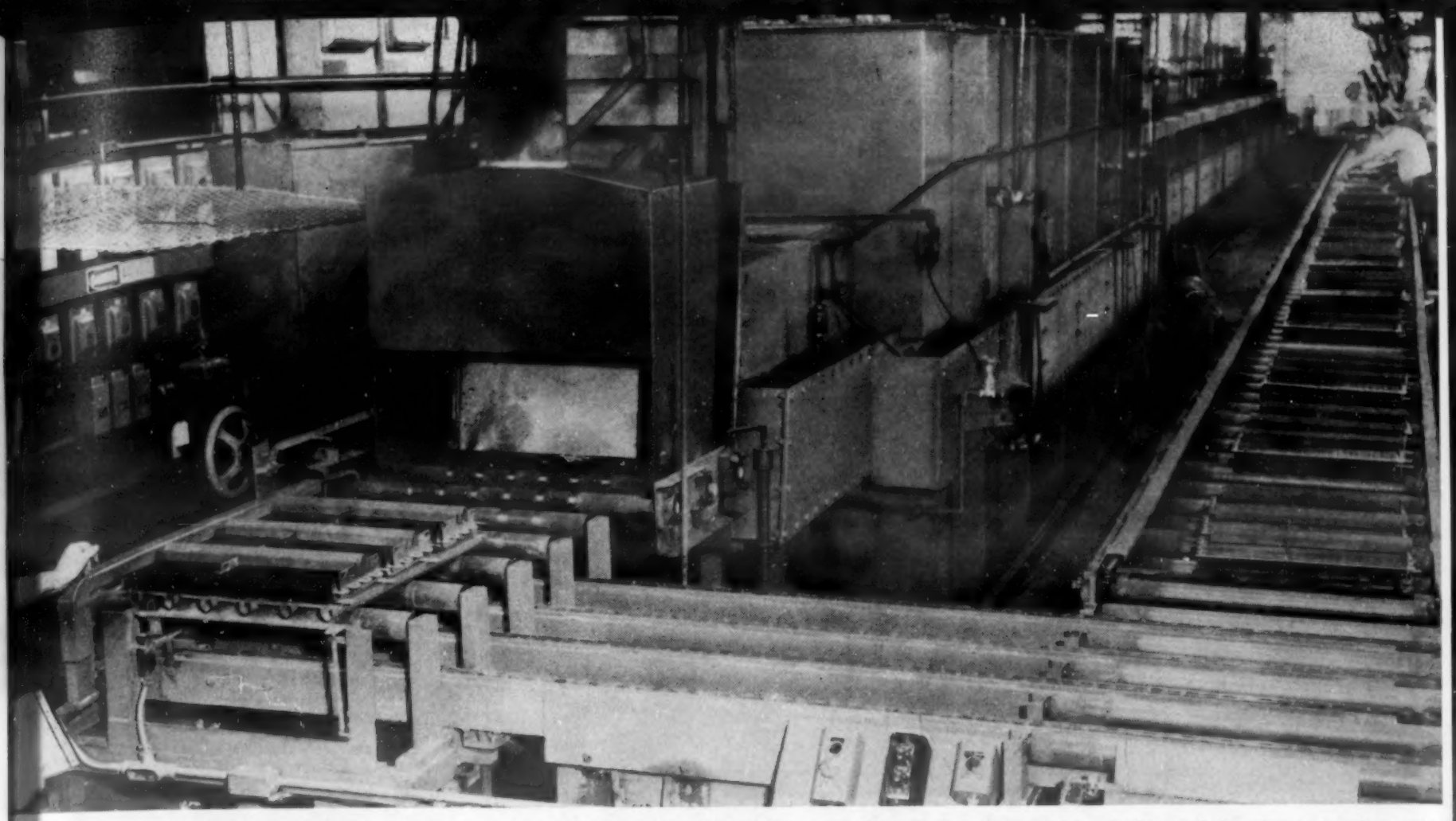
Election of *R. Edward Stein* as vice president in charge of manufacturing for the Lewis Welding & Engineering Corp. has been announced by the company. Mr. Stein joined the organization in 1941 as an engineer. He has held such positions as plant superintendent, works manager of the Welding Div., and general works manager for both the Welding Div. and the Machine Div.

W. J. McCune, assistant general manager of sales at Sharon Steel Corp., has been appointed chief of the Stainless Steel Section of National Production Authority. In Washington, Mr. McCune will direct the distribution of stainless steel for military and essential civilian uses.

To head its expanding facilities, Fisher Scientific Co. has recently appointed Dr. *Samuel W. Levine* as director of development. A researcher in x-ray and emission spectroscopy, the properties of petroleum reservoirs, and hydrocarbon thermodynamics, the chemist was also active in the development of pioneer microwave radar systems in World War II.

Don M. McCutcheon, outstanding Ford metallurgical engineer and a leader in the field of industrial application of applied physics, has been named manager of the Physics Dept. of Ford Motor Co.'s new scientific laboratory.

According to a recent announcement from Rockwell Manufacturing Co., *E. W.*

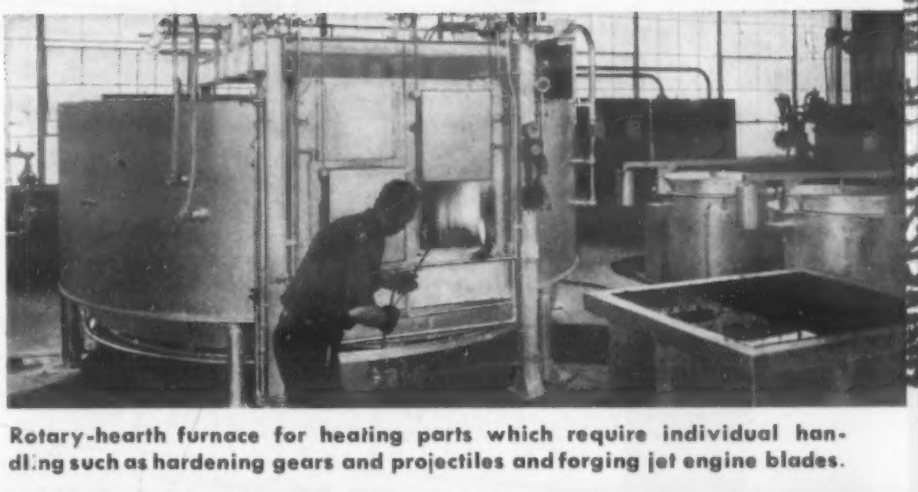


Roller-hearth furnace for high-production continuous brazing of bomb-casing assemblies, annealing shell casings and hardening and drawing jet engine parts.

Get High Speed Heat-treating for Your Defense Production

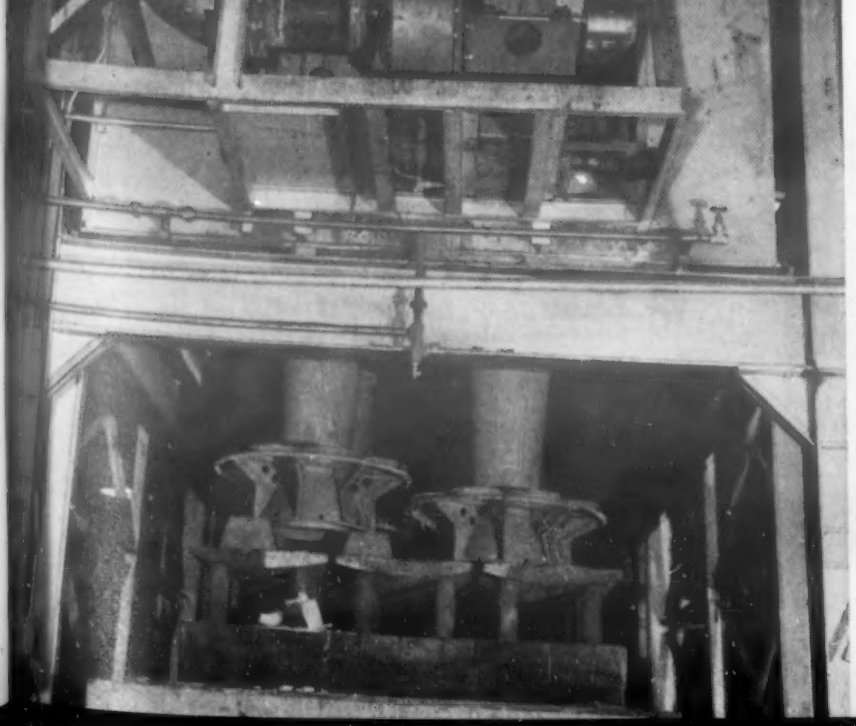
Defense equipment manufacturers are achieving fast production, low over-all cost and high quality products with dependable G-E electric furnaces. And you can benefit in the same way . . . draw on G.E.'s *tested designs* and broad experience from building furnaces since World War I . . . know that your new furnace is dependable during this vital work . . . and will serve you just as ably when you again produce civilian goods.

Present your heat-treating application to the nearby G-E Sales Office, or write to: Sect. 720-50, General Electric Co., Schenectady 5, N. Y.



Rotary-hearth furnace for heating parts which require individual handling such as hardening gears and projectiles and forging jet engine blades.

Elevator furnaces for annealing stainless steel assemblies, aluminum and magnesium parts and malleable iron castings.



Mesh-belt-conveyor furnace for accurate, automatic furnace-brazing, bright-annealing and sintering of small parts.

GENERAL ELECTRIC

720-50

News Digest

Ristau has been elected general manager of the Ohlen-Bishop Manufacturing Co., a recently acquired subsidiary of Rockwell.

Several new appointments and retirements have recently been announced by General Electric Co. Four new appointments in the company's Fractional Horsepower Motor Engineering Divs. include: *J. Herbert Behm,* as assistant to the manager of engineering on special assignments; *Lee R. Beard,* as division engineer of the A.C. Motor Engineering Div.; *Ray D. Jones,* as division engineer of the Development Engineering Div.; and *I. E. Ross,* as division engineer of the D.C. and Specialty Motor Engineering Div. *David C. Prince,* a vice president of the company on the president's staff and formerly head of the company's General Engineering and Consulting Laboratory, has retired after 32 years of service. Mr. Prince plans to enter the consulting engineering field, with headquarters in Schenectady. *Hardage L. Andrews,* an executive vice president of the organization, who during his career has been prominent in both the transportation and home appliance industries, has also retired from the company after 41 years of service. He will be succeeded by *Robert Paxton,* G-E vice president in charge of manufacturing policy, who has been elected an executive vice president. In the Turbine Div., *A. T. Chandonnet* has been named manager of the division. Formerly assistant manager of turbine manufacturing for Fitchburg, *F. S. Kohl* has been appointed operation manager of the company's Fitchburg Turbine Div. Three new appointments to engineering posts in the company's Electric Control Divs. has also been announced: Dr. *Louis T. Rader* has been named manager of engineering; *Harry L. Palmer* has been named as his assistant; and *Benjamin Cooper* has been appointed division engineer of the Electronics and Regulator Engineering Div. New welding posts in the company's Welding Divs. at Fitchburg have recently been assigned: *Raymond C. Freeman* has been named manager, and *Alanson U. Welch* will assume Mr. Freeman's former post as manager of engineering of the Welding Divs. *Alfred F. Fields,* former manufacturing engineer, has been appointed manager of mold manufacture for the Plastics Div. of G-E's Chemical Dept. Mr. Fields succeeds *F. Arthur Gustafson,* who had been temporarily assigned to the post in addition to his duties as manufacturing and materials engineer for the Plastics Div. *D. R. Shoults,* currently the director of engineering for Aro, Inc., has been appointed director of the company's Aircraft Nuclear Propulsion project for the Air Force and Atomic Energy Commission. *Harry L. Erlicher,* vice president of General Electric, has been named special assistant to Under Secretary of the Army, Archibald S. Alexander.

Dr. *Mark E. Putnam* has been elected

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HOSPITAL PATIENTS can relax in every position, from full-reclining to upright, in this sturdy rejuvenating chair made by Barcalo Manufacturing Company. Steel tubing provides the stiffness and rigidity to make the chair steady and reassuring to the patient, yet light to move.

The manufacturer likes the way ELECTRUNITE Steel Tubing works on this application. Uniform ductility and wall thickness assure rapid, predictable forming and bending of the tubes to shape. Where tube ends must be fully flattened at joints, there's no trouble with cracks and fractures. The excellent surface of this ELECTRUNITE Tubing requires no special handling or trick treatments to hold long-lasting finishes under severe service.

Have you considered using ELECTRUNITE Steel Tubing in your essential products, such as these invalid chairs? We'll be glad to discuss your problems . . . and offer you the benefits of Republic's 3-Dimension Metallurgical Service. It's the helpful service that focuses the knowledge and experience of field, mill, and laboratory metallurgists on your fabrication problems.

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News Digest

by the board of directors of The Dow Chemical Co. to the newly created position of executive vice president. Dr. Putnam has been a director since 1941 and a vice president since 1942.

Election to new posts of several American Cyanamid Co. executives has been announced by the Company's president. *E. D. Powers,* vice president in charge of production, was elected to the board of directors, and *A. J. Campbell,* general manager of the Industrial Chemicals Div. and *Howard Huston,* formerly assistant to the president, were elected vice presidents. *L. C. Duncan* was elected assistant to the president.

The promotion of vice president *L. H. Middleton* to the post of director of engineering of The Electric Auto-Lite Co. has been made known by the Company's president. Three new promotions to engineering posts were also announced. *C. R. Boothby* has been named chief electrical engineer, *H. D. Wilson,* chief chemical engineer and *C. C. Cipriana,* chief mechanical development engineer of the division.

Oliver Smalley, president, Meehanite Metal Corp., has been elected a life member of the Institute of British Foundrymen, London, England. The Institute, known throughout the world for its important research and development activities in the foundry industry, confers such memberships only in recognition of valuable services to the entire industry.

J. L. Singleton, vice president in charge of the General Machinery Div. and *R. S. Stevenson,* vice president in charge of the Tractor Div., have been named to the board of directors of the Allis-Chalmers Manufacturing Co. *H. Stanley Bimpson* has been elected to the office of director of engineering of the Company's General Machinery Div. as consulting engineer, according to another company announcement.

Several new appointments have been announced by General Electric Co. Vice Admiral *Willard A. Kitts, 3rd* (USN, Ret.), currently associated with the Company, has been appointed manager of ordnance engineering for Aircraft, Federal & Marine Divs. *William E. Saupe* has been appointed operation manager and *Will Pruessman* has been named manager of manufacturing of the Schenectady Steam Turbine and Generator Divs. *Alfred R. LaCasse,* of the Company's Chemical Div., has been elected general foreman at the G-E Glyptal alkyd resin plant in Schenectady. *Arthur T. Bourgault,* of the Company's Chemical Div., has been appointed manufacturing analyst for the Chemical Materials Dept.

The Zenith Plastics Co. has announced the appointment of *Charles E. Peach* as chief radar engineer on design and an-

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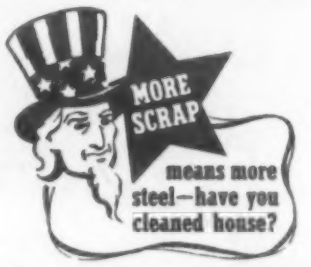
Containing much salient data on "specs," this new Frasse chart will prove a boon when you're working with stainless steels. With it a specified steel can easily be identified in less than 30 seconds—saving valuable time normally spent thumbing through individual specifications.

Compiled by Frasse Technical Service, the chart shows chemical analysis requirements for each of 37 Military, Army, Navy, Aeronautical, and Federal specifications. Also lists specified forms (bars, wire, etc.) and nearest corresponding SAE, AISI and AMS type numbers.

Printed on durable cardboard stock, the chart is regular file card size—can be tacked on wall, filed in desk drawer, or slipped under glass for ready reference.

It's furnished without charge, of course—so make your job an easier one! Send the coupon below for this helpful chart today—and remember that Frasse Technical Field Service is always available to assist you in applications involving stainless steels. *Peter A. FRASSE and Co., Inc., 17 Grand St., New York 13, N. Y. (Walker 5-2200) • 3911 Wissahickon Ave., Philadelphia 29, Pa. (Baldwin 9-9900) • 50 Exchange St., Buffalo 3, N. Y. (Washington 2000) • 157 Richmond Ave., Syracuse 4, N. Y. (Syracuse 3-4123) • Lyndhurst • Hartford Rochester • Baltimore.*



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Bars • Sheets • Strip • Plates • Angles
Wire • Tubing • Pipe • Fittings

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Gentlemen: Please send me, without obligation, a copy of your new data chart, Sec. A No. 2, showing Government "specs" for stainless steels.

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News Digest

alysis. Mr. Peach was active in the field of radio, radar and radome design for North American Aviation and Lockheed Aircraft from 1940 to 1951.

Appointment of Dr. *Raymond C. Machler* as director of research and a member of the executive committee of Leeds & Northrup Co. has been announced by the Company's president. Dr. Machler, formerly associate director of research, succeeds *I. Melville Stein,* who recently was elected to the newly created post of executive vice president.

Alloy Engineering & Casting Co. has announced the appointment of *Walter W. Edens* as defense projects executive. Mr. Edens was formerly vice president of Badger Brass & Aluminum Foundry Co.

Jonathan R. Roebrig has joined National Research Corp. as project manager in the Company's Physics Research Dept.

Announcement has been made of the appointment of Dr. *Edward U. Condon,* noted nuclear physicist, as director of research and development of Corning Glass Works. The announcement was coincident with the acceptance by President Truman of Dr. Condon's resignation as director of the National Bureau of Standards.

Robert B. Battersby, formerly chief engineer of Plastic Manufacturers, Inc., has been named to the newly created position of chief engineer of the Thermo-Setting Div. of Auburn Button Works, Inc.

Walter Most has been appointed assistant to the production superintendent of Div. II of Oliver Iron and Steel Corp. *Mike Wesner* and *James McCrossin* were appointed turn foremen of the Cold Bolt Dept.

The election of Dr. *John B. Davidson* to the office of associate director of research has been announced by Libbey-Owens-Ford Glass Co. Dr. Davidson will supervise research problems pertaining to industrial chemicals, silicones, glues and industrial resins.

Major-General *Thomas F. Farrell,* deputy administrator of the Defense Production Administration, has been appointed assistant general manager for manufacturing, Atomic Energy Commission. General Farrell is on military leave from his post as chairman of the New York Housing Authority, and is on military assignment to the AEC from the Army.

V. H. Ferguson has been elected president of the newly formed Ferguson Equipment Corp.

According to a recent announcement from Westinghouse Electric Corp. *Hendley Blackmon* has been named manager of engineering association activities. Mr. Blackmon will work with company engineers in the preparation of papers to be presented before engineering association meetings.

News Digest

The Duraloy Co. has announced the appointment of *J. W. Zinss* as general manager of operations.

Edward M. Epstein, who has been associated with du Pont's rayon operations almost from its start 30 years ago, has been appointed manager of a newly created quality control section of the Nylon Div.

Howard E. Hornickel, who started his American Steel & Wire Co. career as a blast furnace laborer during his summer vacations from school, was named works superintendent of the company's Donora Zinc Works.

Edward L. Zapp, chief metallurgist, Tube Reducing Corp., died suddenly of a heart attack. Mr. Zapp was active as a member of the New Jersey Chapter of the ASM and was elected a director for the three-year period 1950-1952.

The Allis-Chalmers Manufacturing Co. has announced the death of *William C. Johnson,* executive vice president. Mr. Johnson was a member of the firm's board of directors and also a member of the executive committee of the board. In addition, Mr. Johnson served as chairman of the board of Canadian Allis-Chalmers (1951) Ltd.

The death of *Alfred G. York,* director and vice president of the Watson-Stillman Co., has been announced by the company.

O. S. Tyson & Co., Inc. has announced the death of *Oscar S. Tyson,* founder of the company and chairman of the board.

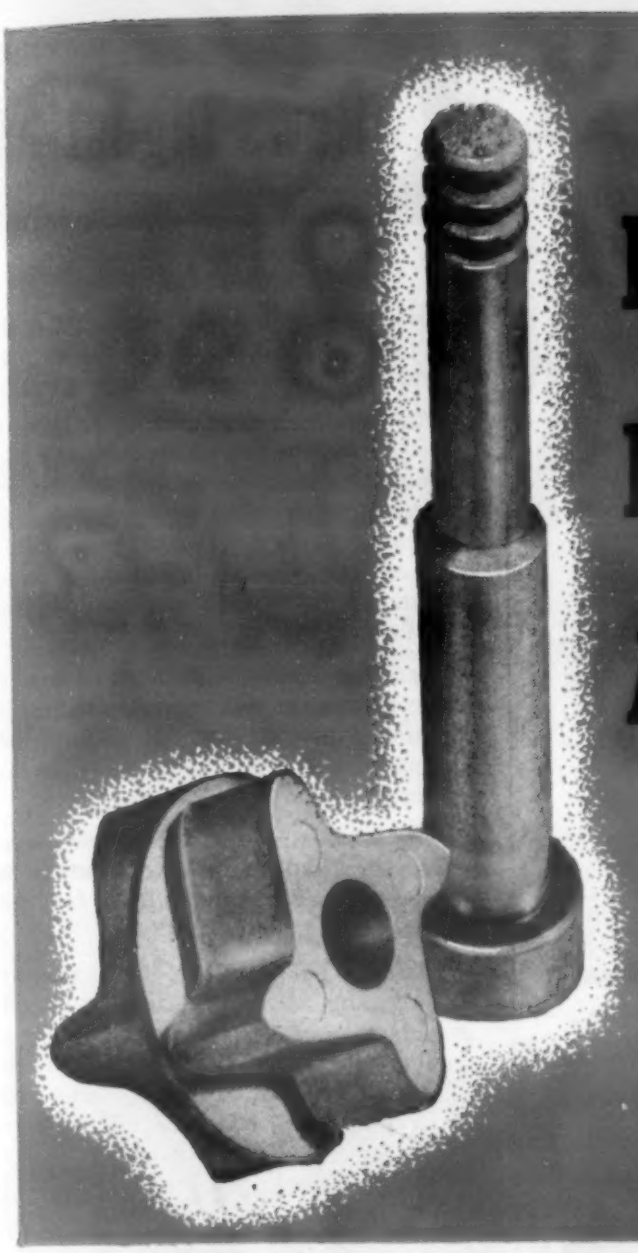
The Ironton Fire Brick Co. has announced the death of its president, *Cecil E. Bales.*

News of Companies

The board of directors at *Dow Chemical Co.* recently authorized construction of a new production plant designed to overcome in part the shortage of benzene. The plant will make vinyltoluene, which appears to be a satisfactory substitute for styrene in the manufacture of some synthetic rubbers, plastics and coatings. Vinyltoluene is made from toluene and ethylene instead of benzene and ethylene.

Philips Laboratories, Inc., has granted to the *General Ceramics and Steatite Corp.* a license under a number of patents pertaining to magnetic ferrites and their manufacture.

United States Steel Products Co. has exercised an option to purchase 23.1 acres



Life of This Tool Increased 17 TIMES After Treatment with HARD'N'TUFF

The die cast zinc rotor shown (left) is subjected to a burnishing operation which removes .02 inches of stock. The tool used (right) normally produced from high speed and hard chrome steels was able to finish only 20,000 to 30,000 pieces before refinishing.

Because of alloy steel shortages and in an attempt to bring about an efficient increase in production the tool was cut from cold rolled steel and treated with HARD'N'TUFF. The user says: "It finally wore out after 500,000 pieces. It held its size all the time it was in use. Previous tools of high speed and hard chrome plate steel lasted approximately 20,000 or 30,000 pieces. What better recommendation could I give your material?"

Here is real proof that HARD'N'TUFF, the steel hardening compound that provides fast effective three-way action;—carburizing, nitriding, chromizing—can solve many part hardening problems.

The metallurgical effect of the action of HARD'N'TUFF provides structural and chemical changes which raise the Quality properties of the low carbon mild steels.

Easy to use—heat the part, dip and roll in the compound; HARD'N'TUFF is non-toxic and can be used on all types of tools, drills, dies, cams, bits—wherever maximum toughness and wear resistance are required. Write for our folder "How to Use HARD'N'TUFF."

Our Guarantee

TOOL LIFE INCREASED 300%

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PURCHASE PRICE REFUNDED

DOUGHTY LABORATORIES, INC.

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News Digest

of land in Pennsauken Township, Camden County, N. J., as a site for the eventual construction of a steel container plant.

An expansion plan costing $6,000,000, which is expected to increase *Norton Co.'s* capacity to make grinding and lapping machines, has been announced by the company. A new 6½-acre plant, which will enlarge Norton's machine tool manufacture by 50 to 60% will be completed by March, 1952.

Cam-Lok Co., manufacturers of welding cable connectors was recently acquired by *Empire Products, Inc.* Henceforth, the company will be known as *Cam-Lok, Division of Empire Products.*

The removal of their plant and general offices to 2620 Crane Ave., Detroit 14, has been annuonced by *Bellevue Industrial Furnace Co.*

Flexible Tubing Corp. has announced the opening of a new division for the manufacture of defense products, the Inflatables Products Div. The new department will concentrate on the manufacture of sleeping pads, life vests, life rafts and products of a similar nature.

A $900,000 program to expand steel making and processing facilities of the *Sanderson-Halcomb Works, Crucible Steel Co. of America* has been announced by the company's president.

Speco, Inc. has recently announced the purchase of all assets of *The Silicone Products Co. of America.* All of the product lines of The Silicone Products Co. will now be manufactured by Speco.

The *Budd Co.* was recently awarded a citation from *Factory Management and Maintenance* magazine commending its contribution to American progress by the construction of a significant new industrial plant, said to be the most modern and cleanest foundry of its type in operation. Lee N. Blugerman, manager of Budd's Red Lion plant, accepted the award.

The *Philadelphia Quartz Co.* is currently celebrating its 120th anniversary, according to a recent company statement. It was July 21, 1831, when the founder, Joseph Elkinton, first opened the doors of his soap and candle enterprise.

Ground was broken this week at Fowlerville, Mich. for the construction of a new factory which will produce die cast plumbing hardware and commercial castings. The new plant will be operated by *Utilex Manufacturing Corp.*, a newly formed division of *Universal Die Casting & Manufacturing Corp.*

The *Alan Wood Steel Co.* celebrated last month the 125th anniversary of its founding.

Kennametal Inc., has announced the purchase of a 20-acre plot of ground near

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then consider..... HIGH STRENGTH at HIGH TEMPERATURE . . .

KENTANIUM

You can really put the heat on this material! It's new. It's distinctive—in properties and performance. It withstands high temperature punishment that quickly weakens and disintegrates conventional heat-resistant materials. It goes through a "fiery furnace" and comes out practically "unscaled" . . . resists oxidation up to 2200°F over long periods, and up to 4500°F for short exposures. Shows no weakening when subjected to the thermal shock of alternate heating and cooling from 1800°F to 180°F in one minute cycles for 100 hours continuously while under tensile stress of 12,500 p.s.i. Superior to best currently-used alloys in stress rupture characteristics from 1500°F up. Much lighter than steels or conventional alloys—a property especially valuable for rotating parts.

KENTANIUM CONTAINS NO TUNGSTEN OR COBALT

Kentanium — our own exclusive development — is chiefly titanium carbide (small percentages of other refractory metal carbides) with nickel "binder." *Uses neither tungsten nor cobalt.* Can be had in various sintered forms—extruded rods, tubes, squares, and flats—simple molded shapes—or more intricate forms that are machined from pressed powder slugs. Not heat-treatable . . . can be worked after sintering only by grinding, to produce required dimensional tolerance or surface finish. Several "grades" are available, with properties to meet specific combinations of imposed conditions.

☆ *If you're sweating over a hot design problem that has you stopped cold, perhaps Kentanium can come to your rescue with possibilities for providing longer life and greater efficiency. We invite your inquiries. Our engineers will be glad to work with you in determining the applicability of Kentanium to your design projects.*

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SUPERIOR CEMENTED CARBIDES

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News Digest

Bedford, Pa., where it will erect a new factory building. Upon completion the new plant will house the company's Mining Tool Fabricating Div.

A 50% increase in production of the *Nox-Rust Chemical Corp.* is expected to result from construction of a new plant designed to meet heavy industrial and governmental demands for its rust-preventive products and petroleum chemicals.

For the ninth consecutive year *E. I. duPont de Nemours & Co., Inc.* has received the National Safety Council's highest award, its Distinguished Service to Safety Award.

A half-mile long manufacturing plant to be used for the production of jet engine components and, after defense needs are met, for electric home appliances will be built near Columbus, Ohio, according to a recent announcement from *Westinghouse Electric Corp.* Also announced by the company is the formation of a wholly owned subsidiary, the *Canadian Westinghouse Supply Co.*, to distribute products of the Canadian Westinghouse Co., Ltd.

General Electric X-Ray Corp., a manufacturing affiliate of the General Electric Co., has become a department of the parent organization, according to a recent company statement. The X-Ray Dept. is now part of the Apparatus Group, which is one of the three main operating groups of G.E. Five other manufacturing affiliates of General Electric have become departments: *Carboloy Co., Inc.; Locke Inc.; Telechron Inc.; Monowatt Inc.;* and *The Trumbull Electric Manufacturing Co.*

To increase production facilities, providing space for new machinery, an enlarged shipping department, and additional offices, *Miller Electric Manufacturing Co.* is now engaged in an expansion program.

Announcement of the removal of the *Niagara Machine & Tool Works* to new and larger offices at 15484 James Couzens Highway has been made by the Detroit branch manager. The new address is in the newly developed section becoming known as Machine Tool Row.

Nice Ball Bearing Co. has recently completed additions to its plant. One addition will enlarge manufacturing space by approximately 9,150 sq ft, while the other addition to be used for storage of raw materials, will cover approximately 5,400 sq ft.

Pennsylvania Salt Manufacturing Co. recently announced Joseph W. Distel as the recipient of its first college scholarship provided for sons and daughters of employees. The scholarship is paid to the college of the winning competitor's choice in four yearly installments of $300 each,

IDEAS *in the making*

ARALDITE* *Bonding, Casting, Coating Resins and* **ARDUX*** *Bonding Resins developed by Ciba Research are simplifying manufacturing methods, improving product efficiency, and opening new fields of product development. Some important new and typical "in use" examples are shown and described here.*

PERMANENT PROTECTION

against destructive action of fatty acids on aluminum walls lengthens service life of new cream whipping dispenser.

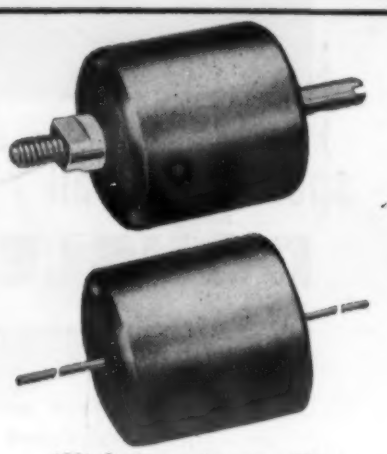
(Kidde Manufacturing Company)

A big problem simply remedied at low cost. The Araldite coating resin used here sets at room temperature, is completely tasteless, odorless and inert, and is characterized by excellent wetting and covering power on metals.

Editor's Note: Araldite coating resins are also being successfully applied as liners for cans and collapsible tubes.

IMPROVED EFFICIENCY

for high voltage capacitators.



(Hi-Q Capacitators, Electrical Reactance Corp.)

Piercing pressure of dielectric material increased greatly by jacketing procedure using an ARALDITE Casting Resin that provides high dielectric strength, arc and humidity resistance, affinity for metals. Transformers weighing many pounds have been potted in Araldite Casting Resins.

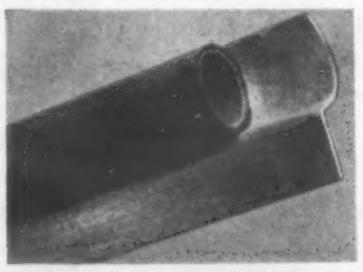
Editor's Note: Among other fields of Araldite Casting Resin use . . . valves and fittings of exceptional corrosion resistance and dimensional stability. Sets without evolution of volatile materials. Requires no pressure.

DURABLY BONDS

metals, (ferrous and nonferrous) to rubber, (natural and synthetic) . . . also wood, thermo-setting plastics, to themselves or to each other.

ARDUX Resins provide much sought properties . . . overcome stress failure and effects of shock loading . . . give high strength at high temperatures.

(Above) Ardux Resin bonds brake linings to brake shoes and clutch plates. Eliminates rivets.



(Right) Rubber tubing bonded with Ardux Resin to aluminum alloy capping strip. (The De Havilland Aircraft Co., Ltd.)

IDEA GENERATORS!

Newest ARALDITE and ARDUX Resins Technical Bulletins are now ready, giving complete technical data on physical properties and recommended procedures. Profusely illustrated with application photographs and diagrams.

Send for your copies . . .

(OR WRITE IN DETAIL ON YOUR LETTERHEAD)

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*Company*_____ *Title*_____

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News Digest

to be applied to his tuition and other fees and expenses.

Wall Colmonoy Corp. announced the opening of its new office and warehouse located at 5815 Clinton Dr., Houston 1, Tex.

In response to the enthusiastic reception of a three-day Welding Clinic held in Baltimore last April, *The Whitehead Metal Products Co., Inc.* has scheduled a more comprehensive clinic to be held in its Buffalo offices and warehouse on Sept. 26, 27 and 28.

Construction has begun on a $2,000,000 project to increase the production of electrical steel at the Butler, Pa. division of *Armco Steel Corp.* A battery of new annealing furnaces is being constructed and equipment is being added to process this special type of steel. Engineers estimate that about ten months will be required to complete the new facilities.

The Raymond C. Crippen Research and Development Laboratories has announced the opening of a new branch of the present laboratories, which will be used exclusively for studying silicones, methods of preparation, analysis, testing, uses and applications, research and development.

An expansion of facilities for the production of basic chemicals at plants in Niagara Falls and Welland, Ont., has been announced by *North American Cyanamid Ltd.* Accelerated defense and civilian demand both in the U. S. and Canada for chemicals derived from products produced at these plants was given as the reason for the expansion program. A further step in the program will be the installation of equipment which will increase American Cyanamid Co.'s capacity for the production of melamine at Willow Island, W. Va.

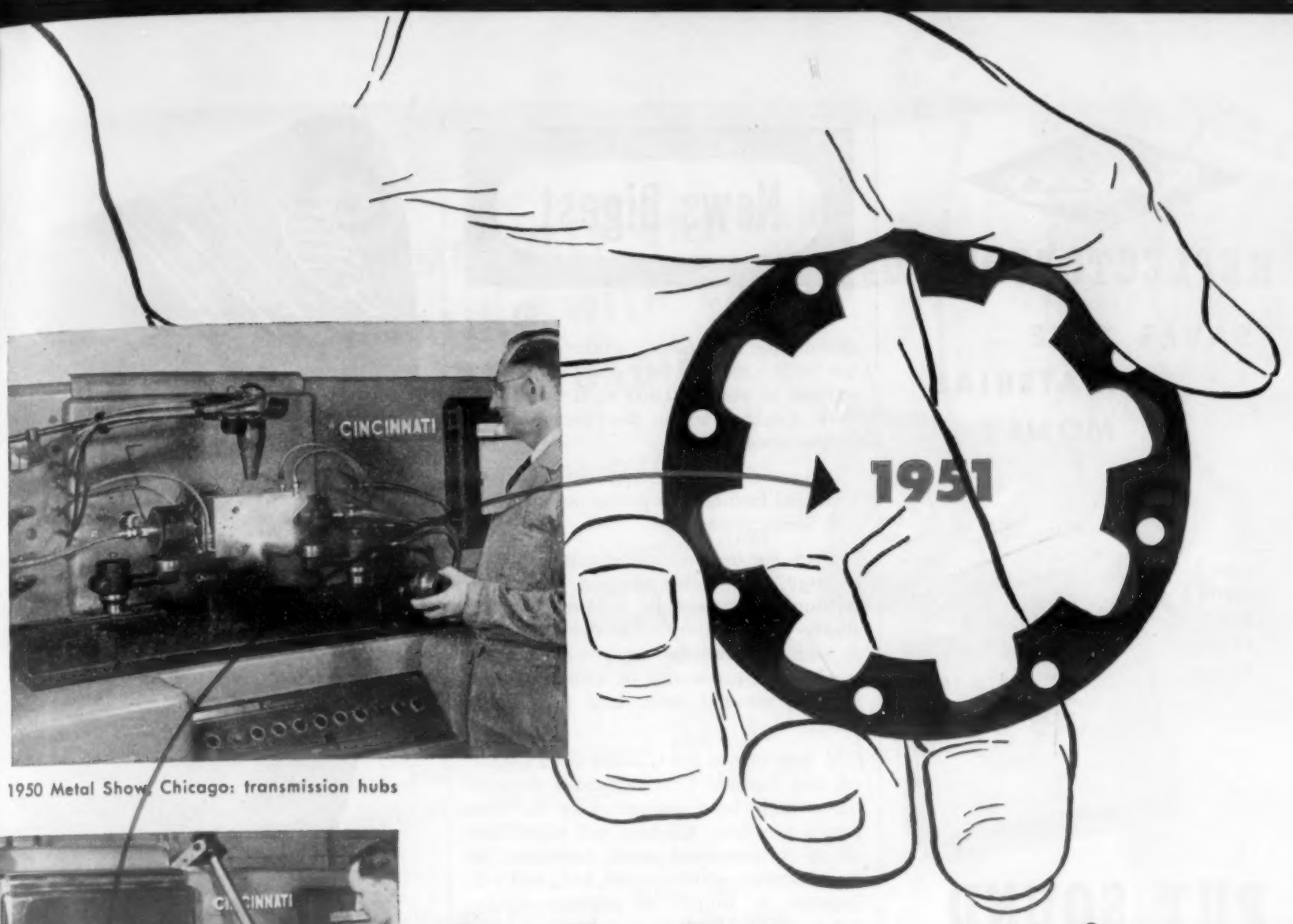
Acryvin Corp. of America has announced the completion of its New Jersey plant expansion for production of their newly developed type of pearlescent plastic.

Acme Manufacturing Co. has announced its new location at 1400 E. 9 Mile Rd., Detroit 20. The new plant is said to allow ample room for present operations and future growth.

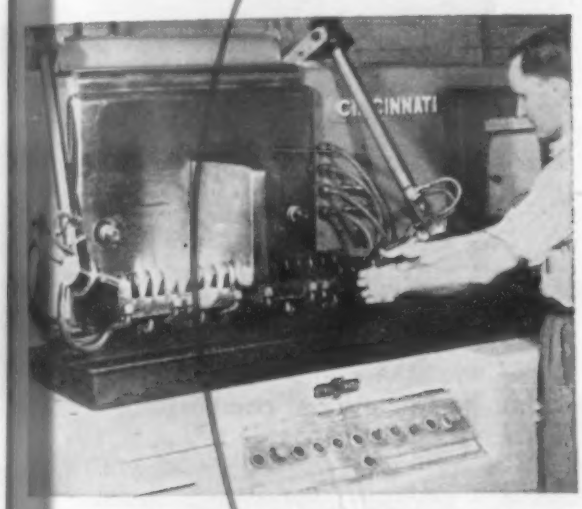
The *Westinghouse Electric Corp.'s* Transformer Div. at Sharon has purchased 6¾ acres of land adjoining the present plant area, according to a recent announcement from the company. Although the ultimate use of this land was not disclosed, the division manager indicated that Westinghouse is looking forward to expansion of its facilities in the Shenango Valley.

The *Bacon Felt Co.* is currently carrying on all its activities from its new Taunton, Mass., factory, where it recently moved from Winchester.

In order to meet the greatly increased

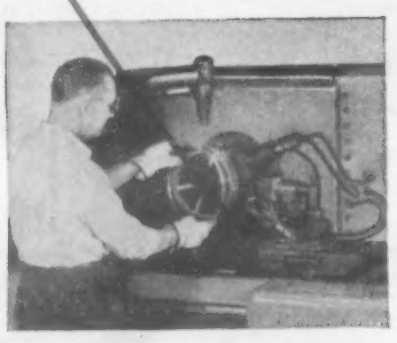


1950 Metal Show, Chicago: transmission hubs



1949 Metal Show, Cleveland: wrench jaws

1948 Metal Show, Philadelphia: drive shafts



1947 Metal Show, Chicago: ring gears

for the fifth consecutive year

Five years ago Flamatic selective surface hardening was demonstrated for the first time—in production—at the Metal Show in Chicago and made front-page news as an important new tool for industry. At each succeeding Metal Show, Flamatic was shown in production on difficult heat treat jobs.

Once again we invite you to—

see flamatic in action

selectively hardening the lobes of an internal cam for a newsmaking automotive transmission. (Flamatic handles 2000 of these parts a day at the customers plant, with practically no rejects.) As in previous demonstrations, you'll be able to learn how Flamatic may help improve your product and lower your costs. Our staff of application engineers will be on duty to give personal attention to your problems.

visit booth G-356
metal show: detroit
october 15-19

flamatic

THE CINCINNATI MILLING MACHINE CO.

Cincinnati 9, Ohio, U. S. A. • CINCINNATI

News Digest

demand for its products, *Miller Motor Co.* has built a modern, new plant comprising an area of about 50,000 sq ft at Melrose Park, a suburb within the Chicago metropolitan area.

Snyder Chemical Corp. has announced increased facilities for production of Synco 128 Series resins.

Plans for the immediate construction of a large new plant addition have been announced by Republic Rubber Div., *Lee Rubber & Tire Corp.* The new 80,000 sq ft addition, and its equipment, will be used for the production of wire and textile braided, mandrel built, lead press cured hose.

A new step in the *Glidden Co.'s* Chemical and Pigment Div. expansion program has recently been announced by the company's president. Glidden will consolidate all of its powdered metal operations on its 25-acre site at Hammond, Ind., and will increase its output of cuprous oxides, cupric oxides, lead, iron and copper powder, as well as its Cubond brazing compounds. Also announced by the company was the disposition of its secondary metals operations located on a portion of the Hammond site. These facilities, which include a lead refinery and equipment for production of type metal, babbit, solder and antimonial lead products, have been purchased by three Chicago businessmen, and will be operated as *Metals Refining Co., Inc.*

Naugatuck Chemical Div., *United States Rubber Co.*, has announced a major expansion program aimed at doubling the production of its Baton Rouge synthetic rubber plant. Plans call for the construction of a new administrative building, laboratory and gate house, as well as new reactors, drying units and other production equipment. New warehousing and latex storage facilities will also be added. The new program is expected to bring plant capacity for the production of Paracril nitrile rubber, Nitrex latex, high styrene latex and high styrene resins to approximatetly 30,000,000 lb annually.

Clearing Machine Corp. has announced the purchase of a 27-acre tract of land in Joliet, Ill., where a modern factory building is to be erected. The new unit will be equipped particularly for smaller and lighter operations, and it is planned to divide work with the main plant on a basis which will make most efficient use of both facilities.

Construction of a new plant near Kansas City for *Fairbanks, Morse & Co.* has been announced. Including machinery and equipment, the cost is placed at $7,500,000.

Establishment of a Technical Div. and an Operating Div. in the Knolls Atomic Power Laboratory near Schenectady, N. Y., has been announced by the *General Elec-*

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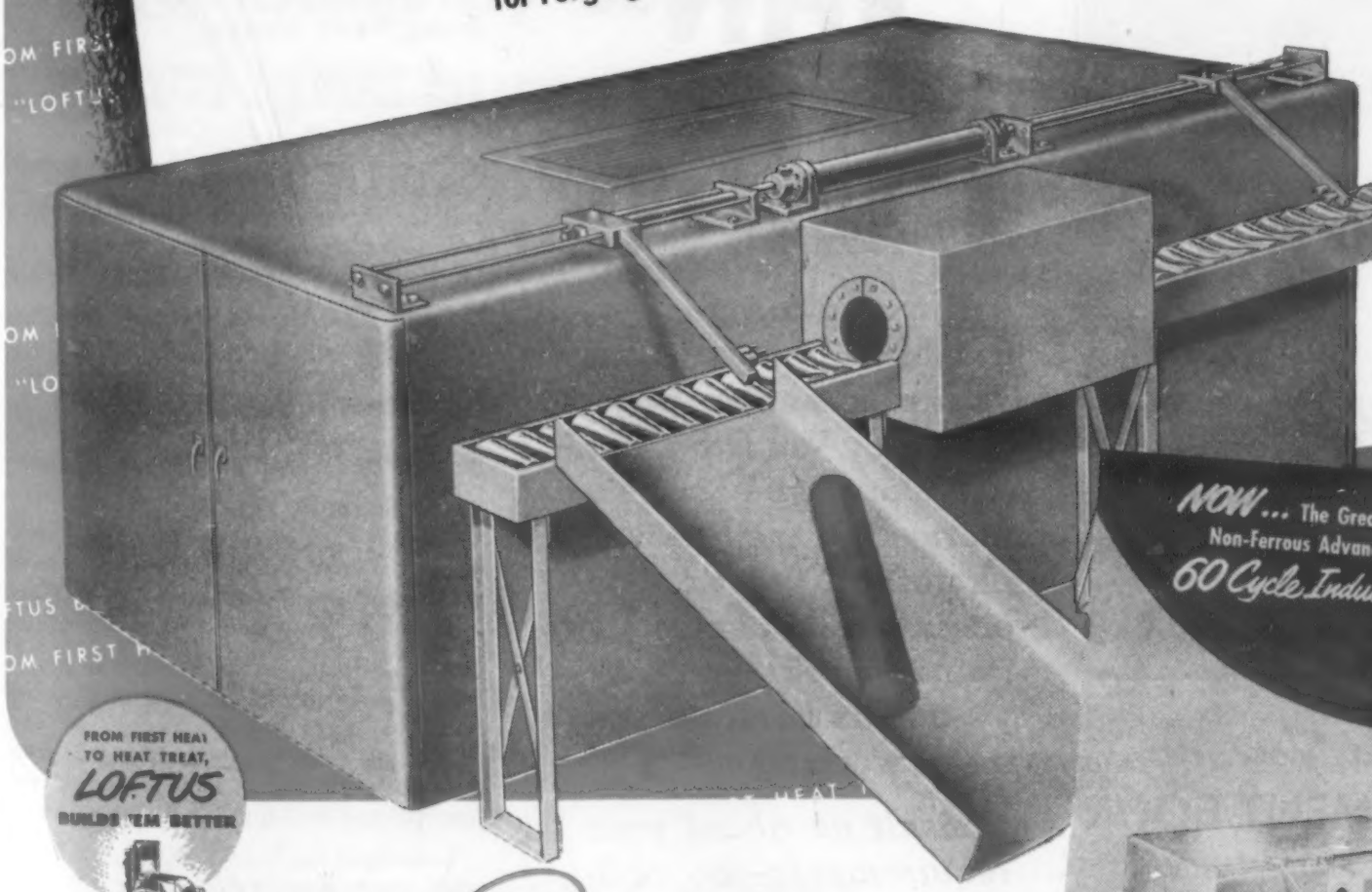

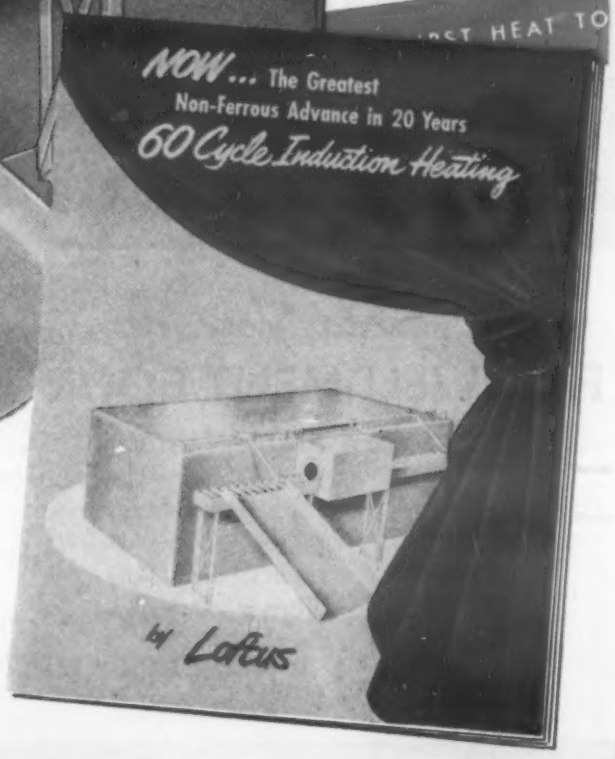

FROM FIRST HEAT TO HEAT TREAT, LOFTUS BUILDS 'EM BETTER

LOFTUS ENGINEERING *Corporation*

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News Digest

tric Co., which operates the laboratory for the Atomic Energy Commission. Dr. Kenneth H. Kingdon was named manager of the Technical Div. and William H. Milton, Jr. was named manager of the Operating Div. When first established, the laboratory's principal project was to design and build an experimental atomic power plant for peacetime use. However, this project has been deferred by the AEC and G-E in favor of one calling for building of an atomic power plant for the U. S. Navy for use on submarines.

Continuing a long string of record breaking safety performances by these and other plants of *American Steel and Wire Co.*, two plants of this U. S. Steel subsidiary have been awarded "Distinguished Service to Safety" Awards by the National Safety Council. One award went to the company's Waukegan Works and the other to the company's American Works in Cleveland.

Castalloy Co., Inc. has announced the reactivation of its magnesium and heat-treated aluminum foundry facilities. It is already back in production of aircraft and ordnance castings, which it specialized in and developed a name for in the field during World War II.

Aluminum Co. of America will expand its research facilities with the erection of a new building at the Company's Aluminum Research Laboratories at New Kensington. The new unit is needed to relieve congestion and to extend ALCOA's research facilities to meet increasing demands of the national defense program.

Branson Instruments, Inc. has moved its plant to a new building located at 430 Fairfield Ave., Stamford, Conn. The new building has twice the floor space of the previous location and will enable the company to expand production.

The Structural Steel Div. and the Steel Deck Div. of *The R. C. Mahon Co.* have completed movement to the company's new ultramodern plant at 6565 E. Eight Mile Rd. at Sherwood Ave., Detroit.

A further step has been taken in *Reichhold Chemicals'* plan to centralize its executive offices in New York City. The advertising staff has moved from Detroit to New York and is now located in the International Building, Rockefeller Center.

Equipment has been purchased and contracts have been awarded for the first building of a new *Brooks and Perkins* plant in the northwest suburban area of Detroit. This will be a modern, jobbing-type mill to roll magnesium sheet from slabs.

Loftus Engineering Corp. has announced that construction is nearing completion on No. 35 and No. 36 Open Hearths at Jones & Laughlin's new South Side plant

How Glass by Corning gave gas pumps a reliable conscience

When you see the paddle wheel spinning, you know gas is being pumped into your car—it's the "gas pump's conscience." Of course it's housed in glass—you've got to be able to see it. But the engineers who designed the pump demanded a lot more of the "glass" than visibility—and got it when they took the problem to Corning.

While a simple appearing piece of glass, it has some tricky requirements for safety and dependability. To meet Underwriters' approval, the glass must stand a test pressure of three hundred pounds. In addition, the surface next to the gasket has to be constructed to form a leakproof, vapor-proof seal. It must also resist corrosion. And all tolerances on the glass must be extremely close to accurately fit into the complete assembly.

The point is this: Corning can produce glass components to meet the most exacting design requirements. We've got the glasses with the properties you need, the engineering and research staff, and the production facilities to solve your most complex problem. So, consult with Corning before your idea reaches the blueprint stage. Or, send today for the informative Bulletins B-83, "Properties of Selected Commercial Glasses" and B-84, "Design and Manufacture of Commercial Glassware."

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News Digest

in Pittsburgh. Eleven 250-ton open hearths are under construction and are included in Jones & Laughlin's 200 million dollar improvement and expansion program.

Plans for increasing the nation's alumina producing capacity by 180,000 tons annually, through the addition of new production facilities at an existing plant in Mobile, Ala., were announced by the president of *Aluminum Ore Co.* The company is also currently erecting a new alumina works at Bauxite, Ark.

The *De Laval Steam Turbine Co.* has announced completion of a new building at 160 Folsom St., San Francisco. The new building will be the Company's new San Francisco headquarters for sales and service activities.

The *Precision Tube Co.* has announced plans for a new manufacturing plant and office building to be located at North Wales, Pa. The plant will produce nonferrous seamless tubing of sizes from 0.500-in. O.D. to 0.010-in. O.D.

Atlantic Steel Co. broke ground for the first phase of a multi-million dollar expansion program designed to keep in step with the growing demand for steel products in the Southeast. The first unit of the program will be an electric furnace with an annual capacity of 100,000 tons of steel.

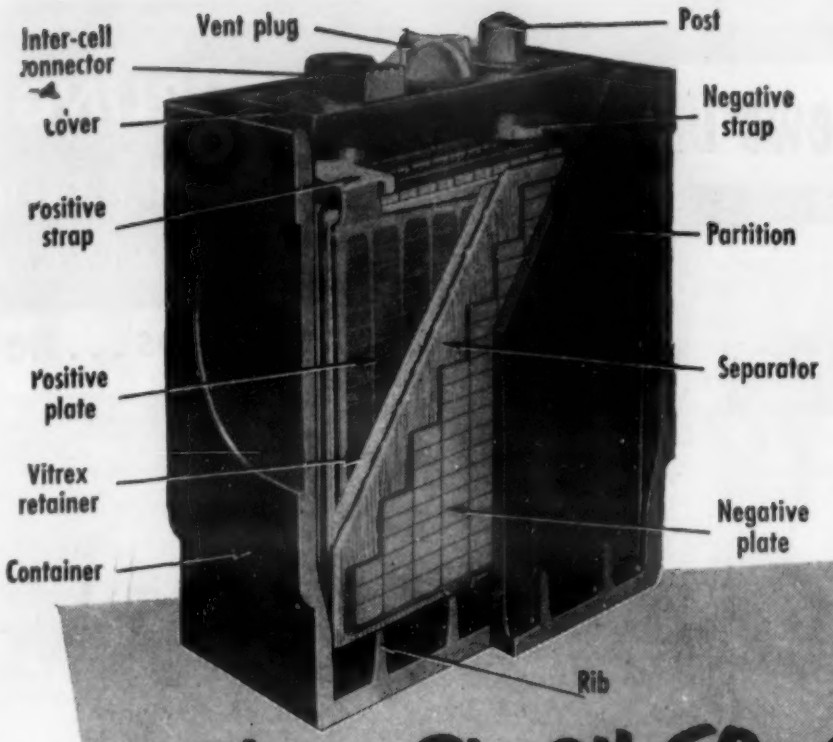
J. M. Martin and C. L. Ramsey of the School of Chemical Engineering, Georgia Institute of Technology, were awarded first prize of $500.00 for papers on "Technological and Research Aspects, Advances and Advantages of the Use of Lower Melting Filler Metals in the Non-Fusion Welding Process", conducted by the *Eutectic Welding Alloys Corp.*

B. F. Goodrich Chemical Co. will construct a new plant in Calvert City, Ky., on a tract comprising 175 acres. Upon completion the plant will represent an investment of more than $5,000,000.

To adequately serve a growing number of users of precision investment castings, the *Hitchiner Manufacturing Co., Inc.* has moved from its plant in Manchester, N. H. to a new and larger factory in Milford.

American Cyanamid Co.'s new $3,000,000 plant in Michigan City, Ind. is now under construction. The plant will produce synthetic cracking catalysts used by oil refiners in making high octane gasoline and other high grade fuels.

The Boards of *Great Lakes Carbon Corp.* and of *Powell Duffryn Carbon Products Ltd.* have announced that an agreement has been entered into under which a jointly owned company, *British-American Carbon Corp.*, has been formed



One cell of a 3-cell 6-volt automobile battery cut away to show construction.

$$PbO_2 + Pb + 2H_2SO_4 \rightleftarrows 2PbSO_4 + 2H_2O$$

this electrochemical reaction accounts for the largest use of lead!

The operation of the modern storage battery is based on a familiar electrochemical principle first applied in 1800 by Volta: Two unlike metals, or unlike forms of the same metal, separated by a porous non-conductive material will, when immersed in an electrolyte, cause an electric current to pass through an external connecting circuit.

The plates of the storage battery are dissimilar forms of lead; the electrolyte is dilute sulfuric acid. The chemical reactions taking place in a storage battery are shown in the diagram at right, and are also expressed as an equation in this advertisement's heading. Reading from left to right, the equation shows the reactions involved in discharge. Passing an electric current through the battery in a direction opposite to that of discharge reverses the action. Read from right to left, the equation thus shows the reactions involved in charging.

Electrical energy in the battery is produced as a result of changing one atom of metallic lead and one molecule of lead peroxide into two molecules of lead sulfate. The metallic lead loses two electrons which convert the lead peroxide to lead sulfate. It is the transfer of these electrons in the circuit which causes the flow of current. The manufacture of battery plates has, for many years, consumed about one-third of all the lead used in the United States. The choice of materials for the storage battery's major elements was based on the following premises: The chemical reaction involved had to be a reversible one so that the battery could be recharged. The materials had to be abundant in nature, available for use in large volume; they had to be resistant to attack by the electrolyte and so related to each other in the electrochemical series as to present the greatest potential (voltage) difference.

Lead meets all these exacting requirements excellently. Of the common metals, it has the highest resistance to sulfuric acid. It is relatively abundant in nature and moderate in cost. It is one element which occurs in two chemical valences and thus provides a relatively high potential difference (2-volts). Last, but not least, around 85% of the close to 300,000 tons of lead used annually in the manufacture of batteries is reclaimed within 2 or 3 years and returned to the market. This use of lead is therefore recurrent and plays a key role in the conservation of the nation's mineral resources.

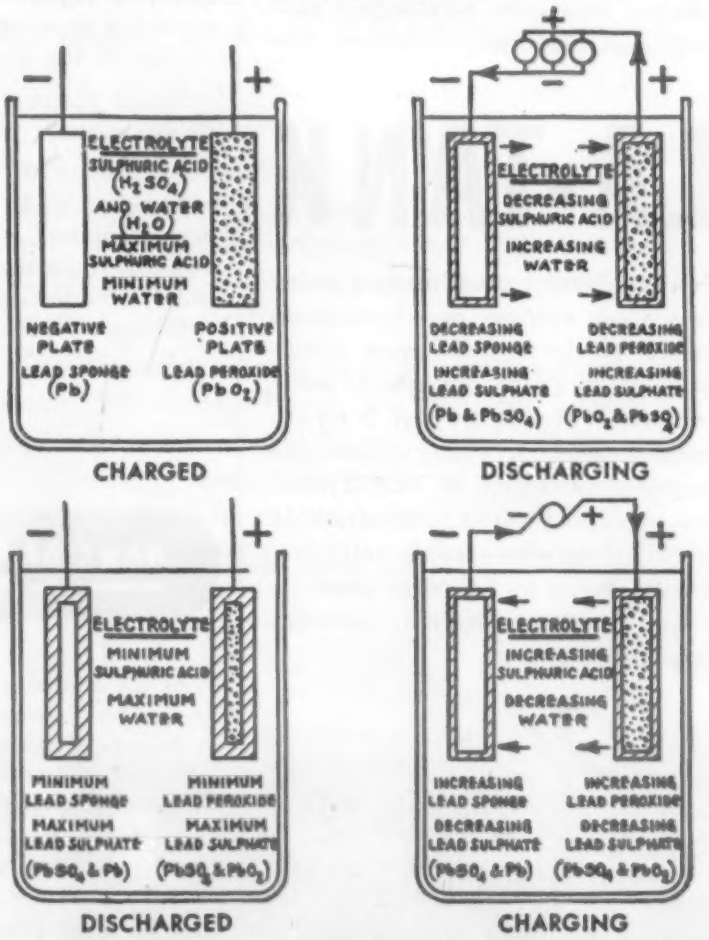


Diagram showing essential action in storage battery.
Courtesy: The Electric Storage Battery Co.

News Digest

in the U. S. to manufacture and sell a wide range of carbon and graphite products used principally by the chemical, metallurgical and process industries. The new company will be the sole producer in the U. S. of carbon and graphite manufactured by the Delanium process.

A formal opening in October has been scheduled by *The National Radiator Co.* of its new one and one-quarter million dollar plant at Duncansville, Pa.

Durez Plastics & Chemicals, Inc. will begin construction of a new $6,371,333 phenol plant, according to a recent company announcement.

Kaiser Gypsum has purchased nine acres on tidewater in the Duwamish district of Seattle as the site of a proposed plant that would be the first complete gypsum products factory in the Northwest area of Washington, Oregon and Idaho. The facilities now in the planning and engineering phase are expected to serve civilian and defense construction in the Northwest, as well as Alaska, Hawaii and other Pacific bases.

According to a recent company release, *Battelle Memorial Institute* will establish a European branch of its laboratories to serve the European economy.

The first large scale and self contained plant for titanium metal production will be constructed at Henderson, Nev. by *Titanium Metals Corp. of America.* The project is expected to increase world production of the metal eight-fold.

Zenith Plastics Co. and the *Brunswick-Balke-Collender Co.* have joined forces in the field of reinforced plastics.

National Tube Co. has established a new laboratory provided with the most modern equipment for testing materials and for conducting extensive research into metallurgical problems.

News of Societies

At the annual meeting of the *American Society for Testing Materials* recently held in Atlantic City, N. J., the following men were elected as officers: Truman S. Fuller, engineer in charge of Works Laboratory, General Electric Co., president; Leslie C. Beard, Jr., assistant director, Socony Vacuum Laboratories, Socony-Vacuum Oil Co., Inc., vice president; John W. Bolton, Rudolph A. Schatzel and E. O. Slater, as members of the board of directors. Other business at the meeting included the pre-

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Fluoroflex-T withstands —90°F to +500°F continuous service. Chemically, it's essentially inert. It is non-adhesive and has little friction. Electrically, it is virtually the perfect insulator for ultra high frequencies.

We'll gladly consult with you on *your* application. Fluoroflex-T rods are available from ¼" to 2" diameter; sheets 21" x 21" in 1/16" to 1½" thicknesses; machined parts to specification. RESISTOFLEX CORPORATION, Belleville 9, N. J.

**Reg. trade name of Resistoflex Corp. for products manufactured from Teflon resin.*

For out of the ordinary engineering with synthetics

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Belleville 9, New Jersey

News Digest

sentation of Awards of Merit to technical leaders in the field of engineering who have rendered outstanding service to the Society, particularly in its technical committee work. Recipients of the awards include: William Blum, chief of the Electrodeposition Section and assistant chief of the Chemistry Div., National Bureau of Standards; Hyman Bornstein, chief technical consultant, Deere and Co.; Robert Burns, member of technical staff, Bell Telephone Laboratories, Inc.; Harry Van Osdall Churchill, head, Analytical Div., Research Laboratories, Aluminum Company of America; Max Hecht, adviser, Power Stations Chemistry; Carl DeWitt Hocker, associate chemistry professor, Union College; William Henry Klein, vice president and operating manager, Lawrence Portland Cement Co.; Horace Hardy Lester, principal physicist, Watertown Arsenal; Stanton Walker, director of engineering and research, National Sand and Gravel Assn.; and William Henry Whitcomb.

Certificates of Honorary Membership were also presented at the meeting to the five following men in recognition of their eminence in technical work in the field of engineering materials and especially for meritorious service to the organization: Thomas G. Delbridge; Albert Theodore Goldbeck; Harold Hudson Morgan; Frank Erwin Richart; and Frederick W. Smither. Authors of outstanding technical papers presented at previous meetings of the Society also were presented with awards at the conference. The authors and papers recognized were: Charles B. Dudley Medal to Professors D. S. Clark and P. E. Duwez, California Institute of Technology for their paper entitled, "The Influence of Strain Rate on Some Tensile Properties of Steel"; Richard L. Templin Award to R. L. Templin and W. C. Aber, Aluminum Co. of America for their treatise, "A Method for Making Tension Tests of Metals Using a Miniature Specimen"; Sam Tour Award to C. T. Evans, Jr., The Elliott Co., for his paper entitled, "Oil Ash Corrosion of Metals at Elevated Temperatures"; and the Sanford E. Thompson Award to R. C. Mielenz, L. P. Witte and O. J. Glantz, U. S. Bureau of Reclamation for their work, "Effect of Calcination on Natural Pozzolans". Another feature of the meeting included the presentation of the Marburg Lecture by F. L. LaQue, who heads the Corrosion Engineering Section of The International Nickel Co's Development and Research Div. Mr. LaQue outlined the inadequacies of accelerated corrosion tests and the advantages and limitations of tests under natural conditions.

At the 23rd annual meeting of the *Lead Industries Assn.*, the following officers were re-etlected for the ensuing year: Felix E. Wormser, president; J. A. Martino, vice president; K. C. Brownell, vice

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Look for this SEAL
When Buying
ZINC DIE CASTINGS

CERTIFIED ZINC ALLOY PLAN

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Whether for military or essential civilian requirements, die castings obtained from any of the companies listed here fulfill *all* ASTM specifications.

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NOW, MORE THAN EVER, you must be sure that your castings are manufactured in a plant which maintains proper alloy control. The CERTIFIED ZINC ALLOY PLAN gives you this assurance.

Send for a bulletin fully describing The CERTIFIED ZINC ALLOY PLAN, how it operates and what it means to the buyer.

A & A Die Casting Co., West Los Angeles, Calif.
The Accurate Die Casting Co., Cleveland, Ohio
Advance Pressure Castings, Inc., Brooklyn, N. Y.
Advance Tool & Die Casting Co., Milwaukee, Wis.

Badger Die Casting Co., Milwaukee, Wis.

Central Die Casting & Mfg. Co., Inc., Chicago, Ill.
Cleveland Hardware & Forging Co., Cleveland, Ohio
Congress Drives Division, Tann Corp., Detroit, Mich.
Continental Die Casting Corp., Detroit, Mich.
Division of F. L. Jacobs Co.
Crown City Die Casting Co., Pasadena, Calif.

Doehler-Jarvis Corp., Pottstown, Penna.
Doehler-Jarvis Corp., Toledo, Ohio
Doehler-Jarvis Corp., Chicago, Ill.
Dollin Corporation, Irvington, N. J.
Du-Wel Metal Products, Inc., Bangor, Mich.

Fanarc Manufacturing Co., Inc., Whittier, Calif.
Federal Die Casting Co., Chicago, Ill.

Glenvale Products Corporation, Detroit, Mich.
Globe Imperial Corporation, Rockford, Ill.
C. M. Grey Mfg. Co., East Orange, N. J.

Heick Die Casting Corporation, Chicago, Ill.
Hilfinger Corporation, Toledo, Ohio
The Hoover Company, North Canton, Ohio

Kamin Die Casting & Mfg. Co., Chicago, Ill.
Kiowa Corporation, Marshalltown, Iowa
Paul Krone Die Casting Co., Chicago, Ill.

Madison-Kipp Corporation, Madison, Wis.
Milwaukee Die Casting Co., Milwaukee, Wis.
Monarch Aluminum Mfg. Co., Cleveland, Ohio
Mt. Vernon Die Casting Corp., Mt. Vernon, N. Y.

New Products Corp., Benton Harbor, Mich.

Paragon Die Casting Co., Chicago, Ill.
Parker White Metal Co., Erie, Penna.
Precision Castings Co., Inc., Syracuse, N. Y.
Precision Castings Co., Inc., Cleveland, Ohio
Precision Castings Co., Inc., Reed Metal Crafts Division, Chicago, Ill.
Pressure Castings, Inc., Cleveland, Ohio

Racine Die Casting Co., Racine, Wis.

St. Louis Die Casting Corp., St. Louis, Mo.
Schultz Die Casting Co., Toledo, Ohio
Sterling Die Casting Co., Inc., Brooklyn, N. Y.
Stewart Die Casting Div, of Stewart Warner Corp. Bridgeport, Conn.
Stewart Die Casting Division of Stewart Warner Corp. Chicago, Ill.
Stroh Die Moulded Casting Co., Milwaukee, Wis.
Superior Die Casting Co., The, Cleveland, O.

The Tool-Die Engineering Co., Cleveland, Ohio
Twin City Die Casting Co., Minneapolis, Minn.

Union Die Casting Co., Ltd., Los Angeles, Calif.
Universal Die Casting Co., Los Angeles, Calif.

Wells Die Casting Co., San Francisco, Calif.
Western Die Casting Co., Emeryville, Calif.

AMERICAN DIE CASTING INSTITUTE, INC.
366 MADISON AVENUE NEW YORK 17, N. Y.

News Digest

president; and R. L. Ziegfeld, secretary-treasurer.

The Galvanizers Committee recently presented its annual award to Nelson Evans Cook, general superintendent of galvanizing, Wheeling Steel Corp. The Committee, which is sponsored by the *American Zinc Institute,* presents an award each year in recognition of distinguished service and valuable contributions to the galvanizing industry or related fields.

According to a recent announcement, Ralph W. Fox has been named chairman of a new structural research department at *Armour Research Foundation* of *Illinois Institute of Technology.* Mr. Fox will head a department to consist of operating sections specializing in stress analysis, structures, materials and instrumentation. Sidney F. Musselman and Dr. Severin Raynor, assistant chairmen of applied mechanics at the Foundation, have been named associate managers of the Engineering Mechanics Div.; Dr. Max Hansen has been named chairman of the Metals Dept., and Dr. William A. Scholes and Harold N. Barr, ceramic engineers from the Fairchild Engine and Airplane Corp., have joined the Ceramics and Minerals Dept., according to another announcement from the Institute. Wilson P. Green, assistant chairman of applied mechanics research at Armour Research Foundation has been promoted to chairman of a new Heat Power Research Dept. Construction of a new research laboratory at the Institute was recently started, and the cost is estimated at $600,000. The building will be used for the expanded scientific and technological research program at the Foundation. Another release for the Illinois Institute of Technology reports the awarding of a one-year scholarship at the Institute to Alfred F. Weinberg by the Women's Auxiliary of the *American Institute of Mining and Metallurgical Engineers.*

The Merit Award of the *American Society of Industrial Engineers* has been presented to United States Radiator Corp. for "leadership in research, engineering, design-styling and manufacture in the boiler and radiator field". The award was presented at the 69th annual convention of the National Association of Master Plumbers at Navy Pier.

A new professorship in metallurgical engineering has been established at *Carnegie Institute of Technology* through a grant from the Jones & Laughlin Steel Corp. The new chair, supported by a grant of $15,000 per year, will be held by Dr. Gerhard J. Derge, professor of metallurgical engineering and a staff member of Carnegie's Metals Research Laboratory. The new chair will be named the Jones & Laughlin Professorship in Metallurgical Engineering.

News Digest

At the annual June meeting of the *Electric Metal Makers Guild, Inc.*, the following officers were elected for the coming year: president—C. C. Spencer, superintendent of melting, Electric Steel Casting Co.; vice president—J. H. Baldrey, superintendent of melting, Allegheny Ludlum Steel Co.; secretary-treasurer — C. B. Williams, superintendent of melting, Massillon Steel Casting Co.

The nomination of Reginald J. S. Pigott, director of the Engineering Div., Gulf Research & Development Co., as 1952 president of the *American Society of Mechanical Engineers* has recently been announced by the Society. Mr. Pigott heads the slate of new ASME nominees, including four regional vice presidents and two directors-at-large. Since only one name is presented for each office, nomination is tantamount to election. The election will take place in the fall, and the new officers will begin their terms at the conclusion of the ASME annual meeting next December.

Election of Warden F. Wilson, general sales manager, Lebanon Steel Foundry, as president of the *Alloy Casting Institute*, national technical organization of leading producers of stainless steel castings, has recently been reported by the Institute. Mr. Wilson, who served as a director of the Institute prior to his election as president, has been active in the institution of intensive research and product development undertakings of the industry.

The 13th edition of *Consulting Services*, 1951, revised and enlarged, published by *Association of Consulting Chemists and Chemical Engineers, Inc.*, has recently been announced. The directory offers the names of consultants specializing in any given field, and may be had by writing to the Association, 50 E. 41st St., New York 17.

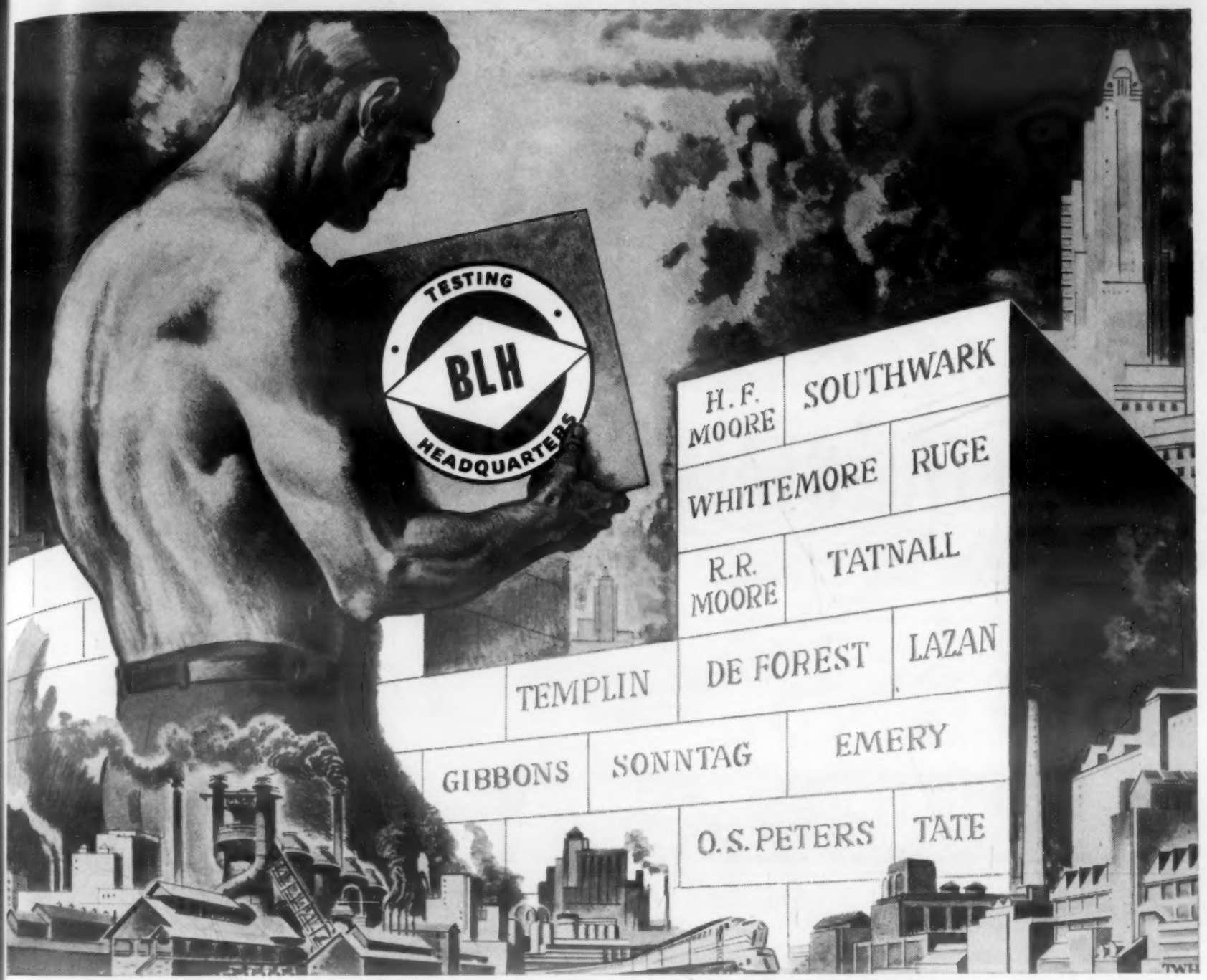
Election of new officers of the *Society of Women Engineers* for 1951-52 are: Miss Hicks, president for a second term; Miss Lillian Murad, Muratex Chemicals, vice president; Mrs. Hilda Edgecomb, treasurer.

The Malleable Founder's Society celebrated the 125th Anniversary of the malleable iron industry in this country at a meeting in Cleveland on Sept. 20 and 21.

Lucio F. Mondolfo, associate professor of metallurgical engineering at *Illinois Institute of Technology*, has been promoted to professor.

The sponsoring of a graduate fellowship at *Carnegie Institute of Technology* by Plaskon Div., Libbey-Owens-Ford Glass Co. has been announced. The fellowship, which will continue for one year, is concerned with work on the syn-

(Continued on page 238)



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News Digest

thesis of 3,3', 5,5'-tetrafluorohydrazobenzene. Samuel Allen Heininger is the recipient of the fellowship, and will carry out his activities under the directon of Professor Robert B. Carlin.

The election of eight members of *The American Society of Mechanical Engineers* to the grade of Fellow has been announced by the society. Engineers with acknowledged engineering attainment, 25 years of active practice in the profession or teaching experience in a school of accepted standing and who have been members of the society for 13 years are eligible for the honor. The newly elected Fellows are: Henry Drake Harkins, supervising engineer, E. I. du Pont de Nemours & Co., Inc.; Frederick P. Fairchild, chief engineer, Electric Engineering Dept., Public Service Electric and Gas Co.; Jay A. Freiday, mechanical engineer, Ebasco Services, Inc.; George P. Jackson, chief engineer, Combustion Engineering-Superheater, Inc.; Dr. George Braxton Pegram, vice president, Columbia University; Paul V. Miller, manager, Small Tool and Gage Div., The Taft-Peirce Manufacturing Co.; William E. Caldwell, staff engineer, Mechanical Engineering Dept., Consolidated Edison Co.; and Charles F. Dixon, supervising engineer, United Engineers and Constructors, Inc.

The Dept. of Metallurgical Engineering of *Rensselaer Polytechnic Institute* has announced the expansion of its graduate curriculum by the addition to its staff as adjunct professors and lecturers outstanding men from the Metallurgy and Ceramics Dept. of the Research Lab. of General Electric Co.

Igor Ivan Sikorsky has been awarded the *Daniel Guggenheim Medal* and certificate for 1951 for a lifetime of outstanding contributions to aeronautics, including pioneering with multi-engine planes, flying boats, amphibians and helicopters.

Cash awards of $500, $200 and $100 are being offered for the most effective slogan submitted for the Fifth National Plastics Exposition, sponsored by *The Society of the Plastics Industry,* to be staged Mar. 11-14, 1952 in Convention Hall, Philadelphia. Any person connected with the plastics industry, its suppliers or its customers is eligible to compete. Entries must be postmarked not later than November 1.

The board of directors of *The Electrochemical Society* has announced that the first Palladium Medal Award has been presented to Dr. Carl Wagner, visiting professor of metallurgy, Massachusetts Institute of Technology. The medal was established in 1950 by the Corrosion Div. of the Society for outstanding contributions to corrosion and to fundamental electrochemistry.

MANUFACTURERS' LITERATURE

Materials

Irons • Steels

Stainless Steel. Armco Steel Corp., 6 pp, ill. Describes advantages of use of stainless steel in meat packing industry and shows ways in which it cuts costs. (1)

Constructional Alloy Steels. Bliss & Laughlin, 46 pp, Sec. X. Detailed technical data on the effects of alloying elements on the properties of SAE and AISI cold finished steels. (2)

Steel Design. Climax Molybdenum Co., 72 pp. Entitled "3 Keys to Satisfaction", booklet provides many design hints to assist designers of steel components. (3)

Tool Steel Selector. Crucible Steel Co. of America. Selects tool steel for desired application. Indicates type steel, hardening depth and heat treating information. (4)

Gray Cast Iron. Gray Iron Founders' Society, Inc. Booklet gives mechanical and engineering characteristics of gray cast iron. Includes details for designing cast components. (5)

Steel Flats. W. J. Holliday & Co., 6 pp, ill, No. 446. Properties of Speed Treat medium carbon steel and its use as hot rolled flats. Includes table of specifications. (6)

Stainless-Clad Steels. Ingersoll Div. of Borg-Warner Corp. Folder describes Ing-Aclad, 20% cladding of stainless steel bonded to backing of carbon steel. (7)

Low Alloy Steel. Inland Steel Co. Data on easy-to-fabricate Hi-Steel, strong, abrasion and corrosion resistant structural steel with high fatigue strengths. (8)

Ferro-Alloys and Metals. Vanadium Corp. of America, 24 pp, ill. The Vancoram Review presents technical articles on applications and developments in ferro metallurgy especially concerned with vanadium alloys. (9)

Nonferrous Metals

Copper and Brass. The American Brass Co., No. B-28. Detailed data on available forms of AnacondA metals and metal products, their properties and outstanding features. (10)

Lead Base Babbitt. The American Crucible Products Co. Data sheets on properties and applications of Promet XXX, lead base babbitt said to have qualities superior to tin base babbitts. (11)

Continuous Cast Bronzes. American Smelting and Refining Co. Catalog gives physical properties, photomicrographs, tables of available shapes and sizes, weights and other technical data. (12)

Punch and Die Setting Alloy. Cerro de Pasco Corp., 20 pp, ill, No. A15. Properties and description of use of Cerromatrix for setting various types of dies and punches. Shows advantages over solid dies. (13)

Phosphor Bronzes. Chase Brass & Copper Co. Folder gives tables of physical and fabricating properties, uses and forms of this company's phosphor bronzes. (14)

Bearing Metals. National Bearing Div., 2 pp. Price list of this company's bronzes and babbitt metals for bearings including No. 397 Silver Babbitt for replacing scarcer materials. (15)

Aluminum. Reynolds Metals Co., 16 pp, ill. Describes process for producing aluminum pig from alumina and shows facilities available at Jones Mills for carrying it out. (16)

Nonmetallic Materials • Parts

Molded Soft Rubber. Acushnet Process Co., 32 pp, ill, No. 50. Describes facilities for making wide range of precision molded soft rubber parts to order. (17)

Felt Parts. American Felt Co., folder, ill. Describes custom-made cut felt parts with applications including separating, protecting, sealing, polishing and insulating. (18)

Plastics. American Hard Rubber Co. Ace Handbook supplies data on hard rubber and plastics useful to the designer of nonmetallic parts. (19)

Plastics Packaging. Bakelite Div., 8 pp, ill, No. G-12. Properties, descriptions and applications of Bakelite and Vinylite coatings, molded and blown products, sheeting and adhesives for packaging. (20)

Bonding Resins. Ciba Co., 4 pp, ill. Properties of new group of resins, their applications as adhesives for metals and nonmetallics, moldings and coatings. (21)

High Strength Plastics. Continental-Diamond Fibre Co., No. GF-50. Properties, descriptions and applications of five of this company's high strength plastics. (22)

To obtain literature appearing on these pages, please refer to easy-to-use reply card on page 245.

Glass Products. Dunbar Glass Corp., 4 pp, ill. Descriptions of this firm's various industrial glasses. Explains advantages of glass to the designer and gives physical properties. (23)

Neoprene. E. I. du Pont de Nemours & Co., (Inc.), Rubber Chemicals Div., 8 pp, ill, No. 45. Discussions of dynamic properties of neoprene and its use for such purposes as vibration control, transformers and tires. (24)

Plastics. Durez Plastics & Chemicals, Inc. *Durez Plastics News* gives up-to-date developments in the use of molding compounds, industrial resins and protective coating resins. (25)

Flexible Tubing. Flexible Tubing Corp., 8 pp, ill, No. 5-4. Applications and performance data on Spiratube flexible tubing for ventilation and materials conveying. (26)

Rubber-Cushioned Parts. General Tire & Rubber Co., 12 pp, ill. Describes General Silentbloc method of mounting, coupling or isolating moving machinery on rubber. Shows standard parts and specifications. (27)

Plastic-Faced Plywood. Georgia-Pacific Plywood & Lumber Co., 4 pp, ill. Applications, properties and description of GPX high grade exterior plywood coated with plastic. (28)

Rubber Reinforcing Resin. Goodyear Tire & Rubber Co., Chemical Div., No. 601-B. Features and applications of Pliolite S-6B resin giving greater plasticity in rubber processing at low temperatures. (29)

Self-Lubricating Bushings. Graphite Metallizing Corp., 8 pp, ill, No. 108. Describes Graphalloy grades for bushings and electrical uses. Bearing design data included. (30)

Cellular Rubber Parts. Great American Industries, Inc., Rubatex Div., 12 pp, ill, No. RBS. Describes properties, uses and advantages of Rubatex closed cell rubber and facilities for making odd shapes to order. (31)

Corrosion Resisting Plastic. Haveg Corp., 8 pp, ill. Uses of various grades of Haveg material, an asbestos with synthetic resin for corrosion resisting process equipment. (32)

Cellulose Acetate. Hercules Powder Co., Cellulose Products Dept., 4 pp, ill. Shows two case histories in which flame-resistant cellulose acetate is used and the advantages of its use. (33)

Reinforced Laminates. Laminated Plastics, Inc., 8 pp, ill. Description, properties and performance comparison of plastics, polyesters reinforced with Fiberglas for heavy duty electrical insulation. (34)

MANUFACTURERS' LITERATURE

Carbon Products. Morganite, Inc., 8 pp, ill, No. 1f. Specifications of various carbon bearings and bushings. Also properties of six series of Morganite carbon products. (35)

Molding and Extrusion Compounds. Naugatuck Chemical Div., 3 pp. Folder of technical data sheets on properties, features, uses and handling methods of Kralastics, plastic and elastomeric combinations. (36)

Molded Rubber Products. Quaker Rubber Corp., 2 pp, ill. Shows examples of molded rubber products this company is able to produce to specification, among other rubber products. (37)

Alumina. Reynolds Metals Co., 8 pp, ill. Description of production of alumina and its application to such materials as plastics, paints, alloy steels and inks. (38)

Molded and Laminated Plastics. The Richardson Co., 4 pp, ill. Describes wide line of Insurok laminated and molded plastics products and facilities to design and fabricate them. (39)

Plastics and Fibrous Materials. Rogers Corp., 8 pp, ill. Describes resources, production, research and development facilities, and products of this company's plants for prime and sub-contracting. (40)

Acrylic Plastic for Aircraft. Rohm & Haas Co., Plastics Dept., 66 pp, ill, No. PL-26. Handbook on Plexiglas discusses available forms for aircraft use, properties, design considerations and installation methods. (41)

Rubber Parts. Stalwart Rubber Co., 16 pp, ill, No. 51SR-1. Describes applications and fabrication of rubber compounds designed to resist temperature, abrasion, chemicals and weathering. (42)

Preformed Plastics. F. J. Stokes Machine Co., ill, No. 509. Detailed properties of preformed plastics, pills, briquettes, or compacts said to be useful in accurate, less wasteful packing of molds. (43)

Inert Plastic. U. S. Gasket Co., Teflon Products Div., No. 300. Description and specifications of available stock of Teflon, chemically inert, electrically resistant plastic. (44)

Metal Parts • Forms

Aluminum Parts. Aluminum Goods Mfg. Co., 56 pp, ill. Catalog covers extensive production facilities and technical services for producing wide range of parts. (45)

Aluminum Castings. Aluminum Industries, Inc., 4 pp, ill, No. 20-A. Describes facilities for the processing of aluminum castings from the design stage to the finished product to customer specifications. (46)

Precision Castings. Atlantic Casting and Engineering Co., 721 Bloomfield Ave., Clifton, N. J. "Quality Precision Castings for Industry" explains advantages of plaster mold process, gives specifications on this firm's alloys. Request on company letterhead.

Small Tubular Parts. The Bead Chain Mfg. Co. Describes Multi-Swage Process for economically custom producing small mechanical parts up to ¼ in. dia and 2 in. length. (47)

Magnesium Parts. Brooks and Perkins, Inc. Folder gives table of characteristics of magnesium alloys, design data and pictures of this company's products. (48)

Stainless Pipe. The Carpenter Steel Co., Alloy Tube Div., 5 pp, ill. Compares this company's Schedule 5 stainless pipe with equivalent standard pipe. Indicates advantages and gives technical data. (49)

Rolled and Welded Parts. The Cleveland Welding Co., 8 pp, ill. Describes welded circular and rolled steel parts, their advantages in economic and physical aspects and their applications. (50)

Steel Castings. Continental Foundry & Machine Co., 32 pp, ill. Booklet presents 12 considerations that should be taken into account in buying steel castings. (51)

Magnesium Forms. Dow Chemical Co., Magnesium Div. Technical information on magnesium, its available forms and applications. (52)

Metal Parts. Dresser Mfg. Div., 13 pp, ill. Folder describes facilities for production of rings, forgings, weldments and other generally circular shapes of various steels and aluminum. (53)

Nickel Alloy Products. Driver-Harris Co., 4 pp, ill. *D-H Alloy Craftsman* describes various applications of Nichrome and monel wires and forms. (54)

Metal and Plastics Parts. The Electric Auto-Lite Co., Bay Manufacturing Div., 16 pp, ill. Shows wide variety of custom-made ornamental and functional metal and plastics parts. (55)

Heat Resistant Castings. Electro-Alloys Div., American Brake Shoe Co., 57 pp, ill, No. T-155. Detailed properties and applications of Thermalloy and Chemalloy heat, abrasion and corrosion resistant alloys. (56)

Investment Castings. Engineered Precision Casting Co., 4 pp, ill. Describes Epco Precision Investment Castings. (57)

Investment Castings. Gray-Syracuse, Inc., 4 pp, ill. Various parts of precision-cast brass, bronze, beryllium copper and steel. (58)

Perforated Materials. The Harrington & King Perforating Co., No. 62. Catalog gives data on fabrication methods, how to order, types of perforation and uses of perforated materials. (59)

Perforated Metals. Hendrick Mfg. Co., 4 pp, ill. Examples of perforated metal applications and various available perforation types. (60)

Precision Investment Castings. Hitchiner Mfg. Co., Inc., 6 pp, ill. Evaluates precision investment casting methods as to costs, production and properties of parts. (61)

Die Castings. The Hoover Co., 12 pp, ill, No. 853. Shows this company's facilities for producing zinc and aluminum die castings. Includes design helps, describes applications. (62)

Helical Compression Springs. Instrument Specialties Co., Inc., 2 pp, ill. How to obtain economical assortment of 1100 beryllium copper compression springs for development work. (63)

Cemented Carbide. Kennametal, Inc., 2 pp, ill, No. 284. Performance reports on high temperature tubing of Kentanium K140A, a cemented titanium carbide. (64)

Powdered Metal Parts. Keystone Carbon Co., Inc., 36 pp, ill. Describes successful applications of powder metallurgy, gives data on correct design of powdered metal parts and detailed information on powdered metal bearings. (65)

Metal Stampings. The Leake Stamping Co., 28 pp, ill. Compares metal stamping with other metal forming methods and shows numerous cases illustrating the advantages of converting to metal stamping. (66)

Centrifugal Steel Casting Data. Lebanon Steel Foundry, 8 pp, ill. Describes centrifugal casting process for producing many symmetrical steel shapes at low costs with great accuracy. (67)

Pressed Parts. Lenape Hydraulic Pressing and Forging Co. Catalog shows numerous parts press formed by this company illustrating the kinds of jobs this firm can perform. (68)

Die Castings. Litemetal Die Cast, Inc., 12 pp, ill. How to select best light metal for die casting. Shows facilities for producing light metal pressure die castings. (69)

Tungsten Carbide Forms. Metal Carbides Corp., No. 50-G. Catalog shows such stock shapes as blanks, bars, strips, rods, tubes, rings and disks of wear resistant tungsten carbide. (70)

Metal Hydrides. Metal Hydrides, Inc., 4 pp. Describes metallurgical and chemical hydrides, their use in alloying, hydrogen production, reduction of compounds, etc. (71)

Aluminum and Zinc Castings. Monarch Aluminum Mfg. Co., folder. File pages on this company's developments in aluminum and zinc casting. Each folder distributed kept up to date. (73)

Seamless Tubing. The Ohio Seamless Tube Co., 12 pp, ill. Shows differences between such tubings as mechanical seamless, aircraft seamless, resistance welded and forged, listing advantages and applications. (74)

Stainless Steel Castings. The Ohio Steel Foundry Co., 4 pp, ill, No. 651-C. Compositions of Fabrite stainless steels for casting and illustrations of numerous corrosion-resistant castings. (75)

Copper Tubing. Penn Brass & Copper Co., 6 pp, ill. Features of this company's seamless copper tubing. Includes tables of safe internal working pressures of various tubing sizes. (76)

Spun Shapes. Phoenix Products Co., Metal Spinning Div., 4 pp, ill. Describes Phoenixspun method for spinning spherical and extra deep-drawn contours. (77)

Powder Metal Parts. Powdered Metal Products Corp. of America. Booklet shows advantages of powder metallurgy in manufacture of such parts as gears, sprockets and valves. (78)

MANUFACTURERS' LITERATURE

Threaded Steel Bars. Joseph T. Ryerson & Son., Inc., 2 pp, ill. Describes available forms and sizes of threaded steel bars. Can be bent to specified shapes. (79)

Stainless Steel Products. Schnitzer Alloy Products Co., 48 pp, ill, No. 50. Sizes, specifications and corrosion data on such stainless products as machine screws, nuts, pipe and tubing. (80)

Spun Metal Parts. Roland Teiner Co., Inc., 4 pp, ill. Describes facilities for spinning metal parts from all types of metal, including stainless steels. (81)

Wire and Strip Metal Parts. E. H. Titchener & Co. Folder gives examples of this company's wire forms, assemblies and light stampings showing what can be made to specification. (82)

Steel Forgings. Titusville Forge Div., Struther Wells Corp., 8 pp, ill. Describes facilities for precision forging of parts regardless of size, metal or alloy. Shows numerous parts produced. (83)

Seamless Tubing. Tube Reducing Corp., 16 pp, ill, No. R2. Describes Rockrite process for making metal tubing to close tolerances. Lists advantages and tubing available. (84)

Steel Castings. Unitcast Corp., Steel Casting Div., folder, No. 1248S. Describes modern facilities for producing and testing high grade molding sand for good steel casting. (85)

Flexible Tubing. U. S. Flexible Tubing Co., 16 pp, ill. Descriptions, applications and specifications of this company's flexible metal tubings, bellows for control units, and other metal parts. (86)

Centrifugal Cast Parts. U. S. Pipe and Foundry Co., 12 pp, ill. Describes centrifugal casting process and advantages and shows three applications improved by this method. (87)

Light Metal Forms. R. D. Werner Co., 4 pp, ill. Explains relative merits of cold roll forming and extruding light metal shapes. Shows company's facilities for both types of fabrication. (88)

Stainless Clad Steel. Alan Wood Steel Co., No. D-97. Properties and applications of Permaclad stainless clad steel affording surface characteristics of stainless steel, formability of carbon steel. (89)

Coatings • Finishes

Zinc Phosphate Protective Coating. American Chemical Paint Co., 4 pp, ill, No. 273A. Shows how coating protects zinc or cadmium surfaces, describes application and automatic equipment for applying. (90)

Protective Coatings. Continental Coatings Corp., chart, No. 1001. Describes applications of bituminous base protective coatings for metals, masonry, insulations and woods against numerous corrosive agents. (91)

Protective Coatings. R. M. Hollingshead Corp., ill. Folder describes Klad Kote corrosion preventives, gives detailed specifications, uses, description and other data in tabular form. (92)

Clear Lacquer. Maas & Waldstein Co., No. 110. Recommends Dulac Clear Universal Lacquer No. 462 for good adherence and retention of desirable surface qualities. (93)

Black Oxide Coating. The Mitchell-Bradford Chemical Co., 4 pp, ill, No. MB-3. Six advantages of Black Magic (Type A) Black Oxide coating process for steel and iron. (94)

Protective Covering. Nox-Rust Chemical Corp. Booklet describes Vapor-Wrapper chemically treated paper said to protect metals against corrosion without use of oil or grease. (95)

Organic Coatings. Parker Rust Proof Co., 7 pp, ill, No. A1031. Discusses effects of various methods of surface preparation on the durability of organic coatings on various metals. (96)

Protective Coatings. United Chromium, Inc., 4 pp, ill, No. MC-4. Describes four different groups of Ucilon corrosion resistant coatings giving properties, advantages and case histories. (97)

Methods and Equipment

Heat Treating • Heating

Induction Furnaces. Ajax Electrothermic Corp., 8 pp, ill, No. 27A. Advantages and applications of, and equipment for induction heating and melting. Includes selector chart for induction heating and melting. (98)

Case-Hardening Process. American Gas Furnace Co. Principles of "Ni-Carb" case-hardening, its advantages, and descriptions of A. G. F. furnaces for the process. (99)

Heat Treating Furnaces. The Electric Furnace Co., 6 pp, ill, No. 461. Installations of numerous gas fired, oil fired and electric furnaces describing features and applications. (100)

Furnace Temperature Indicator. Claud S. Gordon Co., 2 pp, ill. Describes device which quickly indicates any deviation from desired furnace temperature. (101)

High Pressure Oil Burners. Hauck Mfg. Co., No. 456. Descriptions and specifications of high pressure atomizing oil burners. (102)

Heat Treating Furnaces. Holcroft & Co., 4 pp, ill. Features of batch-type, controlled atmosphere furnace shown, including automatic cycle and unit-type construction. (103)

Inert Gas Generators. The C. M. Kemp Mfg. Co., 8 pp, ill, No. I-10. Detailed description of gas generators, their applications and operating principles. Tells which type to use for specific applications. (104)

High Frequency Heater. Lewis Machine Co., Inc., 4 pp, ill. Description, specifications and advantages of this company's induction unit for production brazing, hardening and annealing. (105)

Induction Heating. The Ohio Crankshaft Co. Describes plant survey and possible applications to which induction heating might be put for greater production economy. (106)

High Temperature Equipment. Rolock Inc. Catalog gives data on fabricated heat and corrosion resistant alloys for heat treating uses. (107)

Heat Treating Furnaces. Standard American Engineering Co., 6 pp, ill. Principle of Radivection gas fired furnaces, indi-

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MANUFACTURERS' LITERATURE

cating advantages in more uniform, faster heating for heat treating purposes. (108)

Heat Treating Accessories. Stanwood Corp., 16 pp, ill, No. 16. Describes variety of heat treating accessories including baskets, retorts and carburizing boxes. (109)

Heat Treating Furnaces. Surface Combustion Corp., 4 pp, ill. Operating data on this company's heat treating furnaces for aircraft parts showing several available installations, their advantages. (110)

Cleaning • Finishing

Barrel Finishing. Almco Div., Queen Stove Works, 22 pp, No. F1. Detailed description of barrel finishing indicating advances, advantages and uses. (111)

Hot Dip Galvanizing. American Hot Dip Galvanizers Assn., Inc., 8 pp, ill. Discusses hot dip galvanizing, the problems encountered by galvanizers, and its capabilities. (112)

Automatic Coating Equipment. The Capitol Machine Co., 4 pp, ill. Describes machine designed to spray and bake liquid coatings on parts automatically and with uniform quality. (113)

Wet-Blasting Units. The Cro-Plate Co., 4 pp, ill. Describes new line of wet-blasting units for high production deburring, descaling, stock removal and general finishing. (114)

Descaling Process. E. I. du Pont de Nemours & Co. (Inc.), Electro-Chemicals Dept., 8 pp, ill, No. A-6506. Describes sodium hydride process for descaling metals, advantages and necessary equipment. (115)

Power Driven Brushes. The Fuller Brush Co., 32 pp, ill. Describes Fullergript brushes, their application to such processes as scrubbing steel sheet and tampico brushing. (116)

New Equipment for Coating. The Gyromat Corp., 4 pp, ill. Describes Norris Gyromat, centrifugal spraying machine said to apply standard industrial coatings and finishes faster, more economically. (117)

Barrel Finishing Equipment. Minnesota Mining & Mfg. Co., 12 pp, ill, No. A-1B. Describes barrel finishing, its uses and advantages and suggests new applications for this company's abrasive chips. (118)

Finishing Equipment. The Murray-Way Corp. Catalog describes full line of this firm's automatic polishing, buffing and grinding equipment. (119)

Metal Cleaner. Niagara Alkali Co. Pamphlet gives properties of Nialk Trichlorethylene, high quality metal-cleaning and degreasing agent. (120)

Industrial Brushes. Pittsburgh Plate Glass Co., 30 pp, ill. Twelve case histories on how this company's wire brushes have been successfully applied to abrading, cleaning, finishing and preparation problems. (121)

Welding • Joining

Salt Bath Brazing. Ajax Electric Co., Inc., 4 pp, ill, No. 124. Describes salt bath brazing process, gives several case histories indicating economies, and tells how to order units. (122)

Welding Products. American Manganese Steel Div., 32 pp, ill, No. 650-W. Technical data on Amsco welding rods, electrodes and other equipment for hardfacing and repair. Includes detailed applications. (123)

Silver Brazing Alloys. The American Platinum Works, 4 pp, ill. Descriptions, uses and compositions of Silvaloy silver brazing alloys. Various preforms shown for preplaced brazing. (124)

Alloy Welding Electrodes. Arcos Corp., 2 pp, No. 44822. Data on 11 alloy electrodes for fabrication welding and salvage of both high and low alloy castings. (125)

Welding Positioners. Cullen-Friestadt Co., ill. Catalog shows line of hand or power operated welding positioners with capacities up to 30,000 lb. (126)

High-Strength Welding Rod. Eutectic Welding Alloys Corp. Data sheet on EutecRod 14 FC, high-strength rod for oxyacetylene welding of cast iron said to achieve tensile strengths to 50,000 psi. (127)

Silver Brazing Alloys. Handy & Harman, 24 pp, ill, No. 20. Information on Easy-Flo and Sil-Fos low temperature silver brazing alloys, and valuable data on brazing methods. (128)

Special Fasteners. John Hassall, Inc. Complete line of cold-headed nails, rivets and screws from 1/32- to 3/8-in. dia up to 7-in. lengths in a variety of finishes. (129)

Welding Nickel Alloy. Illium Corp., 4 pp, No. 105B. Instructions for metallic arc and oxyacetylene gas welding of Illium, nickel-base, corrosion resistant alloy. (130)

Solders. Kester Solder Co., 28 pp, ill. Complete analysis of properties and applications of a variety of Flux Core soft solder alloys and soldering fluxes. (131)

Spot Welding Aluminum Alloys. P. R. Mallory & Co., Inc., 36 pp, ill. Detailed description of spot welding for aluminum alloys, plus specifications and diagrams. (132)

Welding Stainless Steels. The McKay Co., 23 pp plus chart. Practical questions and answers to help overcome difficulties in welding stainless steel. Chart gives data on numerous McKay electrodes. (133)

New Fastener. Shakeproof Inc., 16 pp, ill, No. AS-39. Describes Keps preassembled nuts and lockwashers claimed to eliminate lockwasher handling. (134)

Nut Retainers. Tinnerman Products, Inc., 8 pp, ill, No. 245-3. Specifications and descriptions of Speed Grip nut retainers offering a sure method of keeping nuts secure. (135)

Weldments. The Van Dorn Iron Works Co., ill. Information on advantages of weldments and this company's facilities for producing them. (136)

Forming • Casting • Molding Machining

Gas Cutting Machine. Air Reduction Co., Inc. Bulletin gives complete technical data on No. 50 Travograph said to enable either manual or automatic gas cutting of intricate shapes. (137)

Abrasive Belt Contact Wheel. The Carborundum Co., 4 pp, ill, No. AB1. Advantages of longer belt life, less operator fatigue, better finish and less down time explained for "61" Contact Wheel. (138)

Press Brake Dies. The Cyril Bath Co., 48 pp, ill, No. D-50. Catalog shows wide variety of press brake dies for curling, bending, offsetting, channel bending and other forming operations on metals. (139)

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Forged Metal Quality. Drop Forging Assn., 6 pp, ill. Details of several hot working processes emphasizing improvements achieved in metal structure using these processes. (140)

Aluminum Sheet Fabrication. Kaiser Aluminum and Chemical Sales, Inc., 3 pp. Chart suitable for posting in shops indicates minimum recommended radii for the proper bending of aluminum sheet. (141)

Drilling Machine. Wales-Strippit Corp., 8 pp, ill, No. DM. Describes features, setting up, operation and accessories of Wales drilling machine, designed for precision location of holes. (142)

Magnetic Perforating Dies. S. B. Whistler & Sons, Inc., ill. Complete descriptions and applications of this company's magnetic perforating dies. (143)

Inspection • Testing • Control

Weathering Devices. Atlas Electric Devices Co., 28 pp, ill, No. WO-246-T. Principles and uses of, and operating procedures for Weather-Ometer, artificial weathering machine. (144)

Strain Gage. Baldwin - Lima - Hamilton Corp., 1 p, No. 322. Specifications and price of PA-3 Post-Yield Strain Gage said to measure strains of up to 10%. (145)

Contour Measuring Projector. Bausch & Lomb Optical Co., No. D 27. Specifications and features of contour measuring projector claimed to enable very accurate measurements of parts. (146)

Metallograph. Bausch & Lomb Optical Co., 20 pp, ill, No. E-232. Features of Balphot metallograph for microscopic examination of metallographic specimens. (147)

Metallurgical Polishing Materials. Buehler Ltd., 20 pp, ill. Descriptions and samples of emery, aluminum oxide and silicon carbide papers and polishing cloths. Trade names, particle sizes for many abrasives. (148)

Industrial Radiography. Eldorado Mining & Refining (1944) Ltd., Dept. W. Up-to-date information on non-destructive testing of metals by gamma radiography. (149)

Temperature Controls. Minneapolis-Honeywell Regulator Co., No. 189. Specification sheet gives detailed data on features of potentiometers for controlling temperatures as several places. (150)

Compression Tester. National Forge and Ordnance Co., 2 pp, ill, No. 492. Description, features and uses of sensitive, sturdy, low-capacity, compression-crush testing machine. (151)

Portable Hardness Tester. Newage International, Inc., No. ET10. Describes Ernst portable hardness tester for direct, accurate readings in Rockwell or Brinell low, medium or high ranges. (152)

Radiation Pyrometer. The Pyrometer Instrument Co., No. 100. Features and principle of Pyroradiation pyrometer for obtaining spot temperatures in furnaces, kilns, forgings and fire boxes. (153)

Radiography. The Radium Chemical Co., Inc., 48 pp, ill. Details of radium radiography explaining the nature of the equipment and method, recommended techniques and aids to interpreting results. (154)

Materials Controls. Remington Rand Inc., No. KD367. Booklet describes Kardex system for keeping visible materials and parts inventories coordinated with production. (155)

Thermocouples. Arklay S. Richards Co., Inc., 16 pp, ill, No. 5. Descriptions, specifications and advantages of this company's thermocouples and thermocouple accessories. Includes information for ordering. (156)

Universal Testing Machines. Riehle Testing Machines Div., 6 pp, ill, No. RU-3-50. Features, specifications and descriptions of Model MA hydraulic universal testing machines. (157)

Hardness Testing Machine. Steel City Testing Machines, Inc., 2 pp, ill, No. H249. Specifications, operating instructions and description of Model UK-300-H manually operated Brinell Testing Machines. (158)

Pyrometer Wire Color Codes. Thermo Electric Co., Inc. Handy chart gives pyrometer color codes, calibration symbols and parts meeting ISA, military and aeronautical specifications. (159)

Package Testing. United States Testing Co., Inc., 8 pp, ill. Describes methods for testing packages designed for products up to 1000 lb for vibration and impact. Includes prices. (160)

Hardness Testers. Wilson Mechanical Instrument Co., 44 pp, ill, No. RT-46. Descriptions and features of available Rockwell hardness testers and accessories. Shows operating techniques and principles. (161)

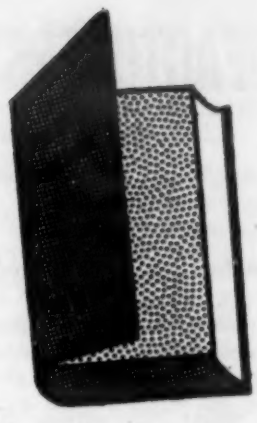
General

Industrial Fans. The Harvey P. Bertram Co., 20 pp, ill. Capacity charts, specifications and other technical data on air fans for heat treating and fume removal use. Describes features of component parts. (162)

High Vacuum Pumps. Distillation Products Industries. Data on high vacuum pumps of unique design for such uses as metal processing and dehydration. (163)

Air Classifier for Dense Materials. Federal Classifier Systems, Inc., 4 pp, ill. Description, specifications and advantages of air classifying units for classifying dense powders according to particle size. (164)

Air Compressors. The Spencer Turbine Co., 12 pp, ill, No. 126-A. Performance curves, capacity tables and detailed descriptions of Turbo Compressors for use in gas or oil fired heat treating equipment. (165)



BOOK REVIEWS

PAINT FILM DEFECTS: THEIR CAUSES AND CURE. *By Manfred Hess. Published by Reinhold Publishing Corp., New York 18, N. Y., 1951. Cloth, 6 by 8¾ in., 544 pages. Price $12.00.* The most complete compilation of paint defects and failures in existence is available in this first English edition, based on the standard German work. This unique book will be of interest to paint manufacturers, and will save much time and money for paint users.

PHYSICAL CHEMISTRY OF LUBRICATING OILS. *By A. Bondi. Published by Reinhold Publishing Corp., New York 18, N. Y., 1951. Cloth, 6¼ by 9¼ in., 380 pages. Price $10.00.* This volume gives you the latest theories on lubricating oils and the physical and chemical principles underlying their action. It is a broad and well documented treatment of specific problems in lubricant technology.

PUNCHED CARDS—THEIR APPLICATIONS TO SCIENCE AND INDUSTRY. *Edited by Robert S. Casey & James W. Perry. Published by Reinhold Publishing Corp., New York 18, N. Y., 1951. Cloth, 6¼ by 9¼ in., 506 pages. Price $10.00.* The primary purpose of this book is to furnish sufficient information to permit the application of punched-card techniques to the individual problems of scientist, engineer or other technologist, whether in the laboratory, field, industrial plant, library, school or executive office. The hand-sorted edge-punched cards are discussed in greater detail than the machine-sorted cards. In fact, one object has been to make the book serve as an operating instruction manual for the edge-punched cards.

NEW METAL POWDER ASSOCIATION STANDARDS. *Published by Metal Powder Assn., New York 17, N. Y., 1951. Paper, 6 by 9 in., 6-page folders. Price 25¢ each.* Two new standards designed to aid both the metal powder producing and consuming industries as well as the metal powder parts user. MPA Standard 14-51T concerns metal powder sintered bearings (oil impregnated) preferred dimensional specifications. MPA Standard 15-51T covers determination of green strength of compacted metal powder specimens.

GUIDE TO FOREIGN SOURCES OF METALLURGICAL LITERATURE. *By John T. Milek. Published by Richard Rimbach Associates, Pittsburgh 12, Pa., 1951. Paper, 8¾ by 11 in., 95 pages. Price $2.50.* This guide has been compiled as an aid to librarians, metallurgists, engineers, students and others interested in obtaining ready access to information on metallurgy published in the foreign literature.

GALVANIZING (HOT-DIP), THIRD EDITION. *By Heinz Bablik. Published by John Wiley & Sons, Inc., New York 16, N. Y., 1951. Cloth, 502 pages. Price $10.00.* Completely revised and reillustrated, the new edition includes the latest methods and processes of hot-dip galvanizing, the metallic rust prevention process in widest use. After describing the nature and use of fluxes, Dr. Bablik devotes the major portion of his book to galvanizing theory and practice.